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# SENT TO THE BOTTOM.

BY RICHARD A. PROCTOR.

(*Continued from page* 342.)

THE most serious defect, however, in our present system of steamship-lighting, does not reside in the obvious weakness of the colour-lights in space-penetrating power, but in their want of significance as signals. As we have said, they scarcely say anything; and a steamship's ordinary fixed signals at night ought to say a great deal.

Yet it is the simplest thing in the world to adopt a method of lighting a ship at night by which not only her true position and bearing but even her distance can be at once known so soon as her signal lights are seen.

I long since suggested a method which seemed excellent to many landsmen, as it did to myself (who had not then crossed the ocean), but which was at once seen by seamen to be inconvenient if not impracticable. It involved the employment of signal lights amidships, which would probably have been ill-seen under average conditions. The plan I am about to suggest is open to no such objection, and I believe to no objection at all except that it requires three signal lights on each side and a good bow light and a good stern light, or if preferred two bow lights and two stern lights one on each side.

What I propose is simply that every steamship should carry three starboard lights, well placed amidships, in this position—

*
*
*

three port lights, similarly placed amidships, but in this position—

*
*
*

all six lights being white; that she should further carry a strong white light in her bows visible only from in front, that is from any point in front of an imaginary horizontal line taken through her amidships line at right angles to her length; and a strong red light astern visible only from points behind the imaginary line just mentioned.

It is easily seen that with this arrangement a steamer's lights would at once indicate her true relative position and bearing. The position of the light-triangle on the side (point to the bows) would show whether her port side or her starboard side were in view; the shape of the triangle would show what angle her length made with the direction line (or line of sight) towards her; and the visibility of the white bow light or the coloured stern light would show whether she were approaching or receding, at that angle with the line of sight.

Suppose for instance that when first any light of a distant ship was seen, only a single white light could be perceived. It would then be known that that ship's course was at the moment directly towards the observer. If on the other hand only a single coloured light could be seen it would be known that her course was taking her directly away. (In such a case, however, the ship from which she was observed would probably be overhauling her, as it would seldom happen that a stern light would be seen *first* in any other way.)

But in general of course the side-light triangle would be visible either when first a ship was sighted or very soon after.

Suppose now the following cases:—

—I.—

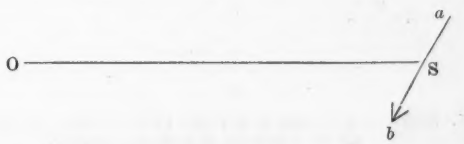
1. The stranger is standing directly across the line of sight as shown, O the observer, S the strange ship, and passing from left to right, so that her starboard lights are seen, and both her bow light and her stern light. The lights then would be thus seen—

*  *  *
Coloured.  White.
*
*

1. STRANGER TRAVELLING DIRECTLY ACROSS THE LINE OF SIGHT (STARBOARD LIGHTS).

—II.—

2. The stranger is crossing the line of sight thus, where




O is the place of the observer, S the strange ship, *a b* her course. Then her bow light would be visible, not her stern light, and the lights seen would appear thus,—

*  *
White.
*
*

2. STRANGER STANDING ACROSS THE LINE OF SIGHT, AT AN ANGLE OF 60°, APPROACHING (STARBOARD LIGHTS).

—III.—

3. The stranger is crossing the line of sight thus (O and S as before),—

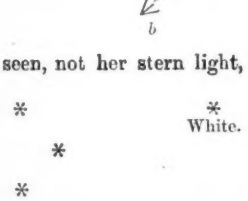
Her stern light would be seen, not her bow light, and her lights would appear thus,—

3. STRANGER STANDING ACROSS THE LINE OF SIGHT AT AN ANGLE OF 60° RECEDING (STARBOARD LIGHTS.)

—IV.—

4. The stranger is crossing the line of sight thus,—

Her bow light would be seen, not her stern light, her side lights thus,—

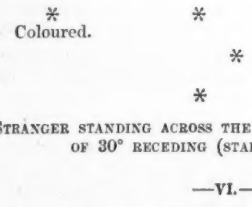



4. STRANGER STANDING ACROSS THE LINE OF SIGHT AT AN ANGLE OF 30° APPROACHING (STARBOARD LIGHTS).

—V.—

5. The stranger is crossing the line of sight thus,—

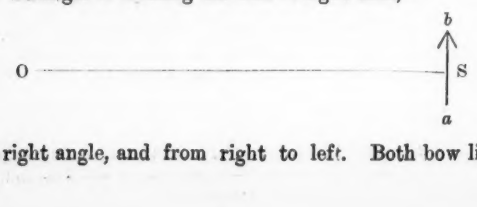
Her stern light would be seen, not her bow light; her side lights thus,—




5. STRANGER STANDING ACROSS THE LINE OF SIGHT AT AN ANGLE OF 30° RECEDING (STARBOARD LIGHTS).

—VI.—

6. Stranger is crossing the line of sight thus,—




at a right angle, and from right to left. Both bow light and stern light would be in view, side lights thus,—

6. STRANGER STANDING DIRECTLY ACROSS THE LINE OF SIGHT (PORT LIGHTS).

—VII.—

7. Stranger crossing the line of sight thus,—

Her bow light would be visible, not her stern light; her side lights thus,—

7. STRANGER STANDING ACROSS THE LINE OF SIGHT AT AN ANGLE OF 60° APPROACHING (PORT LIGHTS.)

—VIII.—

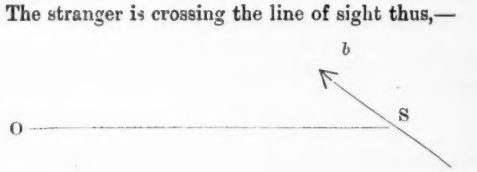
8. The stranger is crossing the line of sight thus,—

The stern light would be seen, not the bow light; her side lights thus,—

8. STRANGER STANDING ACROSS THE LINE OF SIGHT AT AN ANGLE OF 60° RECEDING (PORT LIGHTS).

—IX —

9. The stranger is crossing the line of sight thus,—

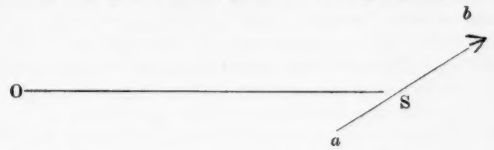



The bow light would be seen, not the stern light; the side lights thus,—

9. STRANGER STANDING ACROSS THE LINE OF SIGHT AT AN ANGLE OF 30° APPROACHING (PORT LIGHTS).

—x.—

10. The stranger is crossing the line of sight thus,—




Her stern light would be seen, not her bow light; her side lights thus,—

* *
Coloured.
*
*

10. STRANGER STANDING ACROSS THE LINE OF SIGHT AT AN ANGLE OF 30° RECEDING (PORT LIGHTS).

In any position whatever in which the approaching ship might be, her course would be at once recognised by the apparent shape and position of the amidships triangle, combined with the visibility of the bow light or the stern light as the case may be. There would be no question of nice or delicate observation, or of signalling,—though suitable signalling (by means of a powerful foghorn) of the course which each ship was about to keep, would be most useful later. So soon as the lights were clearly seen the veriest landlubber could see how the stranger's hull was situate, as readily as the best seaman on board.

*(To be continued.)*

## ELECTRO-PLATING.

V.

BY W. SLINGO.

ELECTRO-TYPING, that species of electrical deposition to which brief reference was made in the previous paper, is an art which has been largely and successfully cultivated. No conception can be formed of the quantity of copper so deposited year by year, or of the more than thousand and one objects for which the system is adopted. Notwithstanding, however, the large experience and practice of the past, recent demands are calling forth further advancements. Recently an electrolytic bath was constructed to hold some 70,000 gallons of solution, and capable of taking a type or copy of a statue of the most colossal dimensions. Obviously the amateur will not commence by attempting large or difficult works. His best course would be to start with small and simple articles. Coins and medals in good condition and in deep relief afford excellent practice. As it is manifestly impossible to take a copy of both sides in one piece, it is better to attempt one at a time than to try copies of the two sides simultaneously. There are several methods of copying the above-mentioned articles available. One is to obtain a deposit direct from the metal. This is accomplished by attaching a copper wire to the coin, either by soldering on the back or twisting firmly and securely round the rim. The side which is not to be taken, and which has been called the back, is well coated with an insoluble insulating material, such as wax or gutta-percha. The former may be applied by dipping the back of the coin two or three times in a shallow vessel containing the melted wax. The application of a percha coating is, perhaps, a trifle more troublesome. The copper wire having been fixed, the coin is fitted, face downwards, in a hole previously cut in a piece of wood or a stout piece of cardboard. The exposed surface of the metal is then either heated or coated with an indiarubber or gutta-percha solution, made by dissolving the insulating substance in bisulphide of carbon, which evaporates very quickly, and which may be obtained at any druggist's. It is to be observed that the bisulphide is a volatile and highly inflammable liquid, and should, therefore, be kept at a respectable distance from a flame.* A piece of gutta-percha is then warmed and rolled into a ball, which is placed on the centre of the coin, and worked out till the whole coin is covered. A weight is then placed on the percha and kept there till it is thoroughly set. On raising the coin the face to be copied is coated with plumbago, brushing it into the crevices with a soft brush, and rubbing the smooth surfaces with the finger. Thus prepared, the coin is placed in the bath, and a coating of copper deposited on the plumbagoed surface. When the coating is sufficiently thick, it is separated from the coin and exhibits a reverse representation of the picture. Should there be any imperfection, it arises in all probability from a faulty plumbago surface. When the bath is small, the surface of the coin should be parallel with the anode; but of this more anon. To obtain a real or direct representation of the coin, the coating or mould is insulated on the back, plumbagoed on the face, and attached to a copper wire immersed in the solution.

This method affords instructive practice; but a more expeditious one is to obtain a reverse mould composed of wax, gutta-percha, plaster of Paris, fusible alloy, or some other available material.

To obtain a wax mould, a little oil is rubbed over the surface of the coin to prevent the wax sticking, a strip of stout paper about an inch wide bent round the edge and fastened with a little sealing-wax, the coin is warmed, and then into the receptacle made by the paper rim some white wax which has been heated to a trifle above the melting point is poured. The coin and wax are then put in a cool place until the latter is quite set, which generally takes several hours. When cool the wax is removed, and a piece of copper wire bound round the edge for purposes of connection. The face of the mould is then carefully and thoroughly plumbagoed, the plumbago making contact with the binding wire. It is then placed in the bath. As the plumbago is the conducting material, care is taken that it is not placed anywhere where the copper is not required. Should it get on the back, some difficulty may be experienced in separating the mould from the electrotype. In the event of the plumbago getting where it is not wanted, it should be covered with a little insulating varnish. Copper which has found its way to the back of the mould may, however, be broken off, or, if that is impracticable, as is frequently the case, a file may be used to effect the necessary separation.

Plaster-of-Paris makes very good moulds if it is of the finest description. After slightly oiling the coin, a paper rim is bent round it, as in the process of making a wax mould. Plaster is mixed with water to about the consistency of treacle, and a little of it brushed carefully over the surface of the coin, so as to ensure a perfect representation. The receptacle is then speedily filled with the plaster, which soon dries, and forms a good solid mould. It is, however, porous, and should be saturated with wax, which

* A little bisulphide of carbon on being burnt in a saucer on the hob readily extinguishes a chimney fire by forming, in combination with the oxygen of the air, carbonic and sulphurous anhydrides, gases which do not support combustion.

is accomplished by placing the mould in melted wax, back downwards. The ivory-like surface assumed by the plaster and wax shows plainly when the wax has done its duty. The mould is then bound with wire, and plumbagoed as before, and afterwards immersed in the bath.

A good mould is obtained by using a mixture composed of two parts of gutta-percha to one of marine glue, which is cut up into very small pieces and then heated gently. The compound is well stirred to ensure thorough mixing. A thin brass or copper rim having been fixed round the edge of the coin, a warm, soft ball of the compound is placed on the centre and worked outwards to facilitate the exclusion of air bubbles. A gradually increasing pressure is then applied, and after about two hours, the mould, being cool, may be removed with a gimblet. The slight contraction due to the cooling of the compound renders its removal easy. This mould, after being wired, requires, like the others, to be plumbagoed.

Of fusible alloys there are several, but mention need only be made of one, which is composed of eight parts by weight of bismuth, five of lead, and three of tin. The metals should be well mixed and made as homogeneous as possible, the fusing point of the alloy being about 212° F. To obtain a mould a little of the mixture is poured on a stone slab, the surface skimmed with a card, and the coin dropped on it. When cold, the coin is removed, the back of the mould varnished to prevent the deposition of copper there, and the face plumbagoed, a wire being attached for the purpose of connection. Ordinary coins are never "undercut," but when such a surface is to be copied, special elastic moulds are made, unless it is preferred to make the electrotype in two or more pieces. A serviceable elastic mould is made by breaking a quantity of the best fine glue into small pieces, and soaking them in just enough cold water to cover them. When thoroughly dissolved, any superfluous water that may be present is decanted. The gelatinous mixture remaining is then heated with one-fourth the quantity of dissolved glue to nearly the boiling-point of water. The function of the treacle is to prevent drying and consequent shrinking. To obtain a mould, the surface of the medallion is oiled and a paper rim fastened round the edge. The mixture is poured in while hot, and stood aside for some hours to dry. The paper is then removed, and the mould very carefully detached. Its face is plumbagoed and its back varnished with the india-rubber solution. To prevent as far as possible the absorption of water by the mould (and its consequent swelling) a concentrated copper solution must be employed.

## HOW TO GET STRONG.

(*Continued from p.* 323.)

### FROM KNEE TO TOES.

HOWEVER absurd some of the common notions about shapeliness may be—as for instance that a small hand or foot is to be admired merely because small, though possibly too small and altogether ill-shaped—there is good reason for the common prejudice in favour of a well developed calf (or preferably a pair). Although footmen and ballet-dancers shame most of us as regards this particular development, and yet are not the most esteemed products of civilisation, there can be no doubt that the shapely calf indicates racial advance. The lower races of savage man are calf-less. The higher savage races have very queer calves, to say the least of it. In civilised races the lower types have the worst calf development. It is only in the highest civilised races, and in the best specimens of these races, that we find the shapely calf shown in Greek sculptures.* I take back indeed what I said just now, or seemed to say, about footmen and ballet-girls. Their development of calf is great, but to the artistic eye unsatisfactory. There is something manifestly wanting in intellectuality about this portion of their understandings. Their limbs below the knee are as out of proportion as a blacksmith's arm,—and though as I wander through galleries of modern sculpture I am sometimes led to suspect that artists have occasionally taken such calves as footmen and ballet-dancers possess for their models, I am sure no sensible sculptor would take the legs of John Thomas or of Signorina Toanheli as samples of masculine or feminine perfection of form, any more than he would copy the arm of a blacksmith in fashioning the statue of an Apollo.

I do not advise a series of energetic exercises for the calf; but I do strongly advise that so much exercise should be systematically given to it that it may be developed in due proportion. Where the calf is small and weak, it may with advantage receive a larger share of attention.

The first exercise I would suggest is a very simple one, but instructive as showing what is the work for which the calf muscles are intended. But the exercise is also good for the knees. (I may remark in passing that so many of the exercises I have suggested for the thighs and body, and many of those which I am about to suggest for the leg below the knee, are good for making the knees supple, lissome, and strong, so that I do not think it necessary to describe special exercises for this purpose.) Walk a hundred steps (in your bedroom or sitting-room, if you like), on the toes, letting the body sink well at each step as the heel draws near the ground, and be springily raised as the heel rises. There is no exercise in this, you probably think, as you take the first ten or twelve steps; but by the time you have taken a hundred steps you will find your knees beginning to be rather tired (if you have kept up properly the alternate rise and fall of the body). The calves have not apparently been very much tried. Yet as you rest after the exercise, a certain something suggests that the calves have been "got at."

It is the rising and sinking of the heels which has given the calves work. Therefore, attend now especially to this particular movement. Standing with the head well up, chest out, and shoulders thrown back, the knees set as if you were about to begin the toe-touching exercise already described, and the feet pretty close together but not touching, and *the toes turned out*, steadily rise on the toes, after the ballet-dancer's fashion, as high as you can. Then slowly lower your heels till they touch the ground,—keeping the knees all the time well back. Steadily rise again till you are standing on tip-toe. Sink again. As you next rise, slacken your knees a bit and lower the body till you can feel the calf-muscles, and note how they tauten as the body is being raised. Resume the straight-knee condition, and steadily rise and sink from the toes as before. Repeat as long as convenient,—forty to fifty times the first day, but later you may take several hundreds. There is no exercise which more directly affects the calves than this. "A gentleman of our acquaintance," says Blaikie, "of magnificent muscular and vital developments, was not satisfied with the girth of his calves, which was 14¼ inches. At our

* We may recognise the significance attached to the calf as one of the most characteristically human developments in the old custom referred to in Tennyson's "Princess" in words which many readers have found perplexing—"Married to a booted calf." Obviously the calf, well booted, was regarded as aptly symbolising the man himself.

suggestion he began practising this simple raising and lowering of the heels. In less than four months he had increased the girth of each calf one whole inch. When asked how many strokes a day he averaged, he said, 'from fifteen hundred to two thousand,' varied some days by his holding in each hand during the process a 12 lb. dumb-bell, and then only doing one thousand or thereabouts. The time he found most convenient was in the morning on rising, and just before retiring at night. Instead of the work taking much time, seventy a minute was found a good ordinary rate, so that fifteen minutes at each end of the day was all he needed. But this was a great and very rapid increase, especially for a man of thirty-five; far more than most persons would naturally be contented with, yet suggestive of the stuff and perseverance of the man who accomplished it."

However the exercise is a rather slow one, though effective enough. Many others are available which if they do not act so directly on the calf are better for the general development of the leg.

Quick walking with hard pressure of toes and soles against the ground will be found very capital work for the feet and calves. Walking up hill in the same way is even better. Blaikie strongly recommends running on the fore part of the feet. But as running on this part of the feet only, is not good running, and it is a pity to spoil the style, I would simply recommend the careful avoidance of flat-footed running. It is neither well to run with too much foot action nor with too little as when running flat-foot. By aiming at a style between the two, you get the most effective form, and at the same time develop well the muscles of the calf and of the upper thigh. Note that in the actual drive back with the lower limb by which forward propulsion is accomplished, the heel should come first to the ground (whatever runners may say, and doubtless believe, about the heel not touching the ground at all), then the mid-sole, and finally the ball of the foot and the toes, the last forward effort coming from the front of the foot. In this part of the leg stroke the knee should be well back. If special attention is directed to this part of each stride, the calves will get an extra allowance of work; while the running style will be perceptibly improved. But if you care to get a quick style, avoid over-springiness. The spring of the gait should only suffice to reduce the vertical impact to a minimum, taking off the jar which is perceptible in flat-footed running; but any springiness by which an unnecessary rise and fall of the body are produced is a fault of style, and involves more or less waste of strength or loss of velocity or both.

Blaikie further recommends hopping, which is no doubt the most effective of all exercises for enlarging and hardening the calf. But skill in hopping is not worth very much in ordinary life. The accomplishment is one which most persons would prefer to avail themselves of in private,—and even in a bedroom persistent hopping might be regarded as a rather objectionable practice. The only advantage of hopping is that it tells very quickly and tires very soon.

Jumping is far more satisfactory, being in the first place much more useful, tending to strengthen and improve more limbs and muscles than hopping, and having a saner aspect in public. You can often get the chance of taking a good run across a heath or common presenting abundant opportunities for light leaping.

GAS IN PARIS.—The dividend of the Parisian Company for Lighting and Heating by Gas for 1883 is at the extremely liberal rate of 27½ per cent. per annum. Although this was an extremely satisfactory result, it was scarcely so good as that obtained for 1882.

## COINCIDENCES AND SUPERSTITIONS.

BY R. A. PROCTOR.

(*Continued from page* 327.)

I HAD intended to pass to the consideration of those appearances which have been regarded as ghosts of departed persons, and to the study of some other matters which either are or may be referred to coincidences and superstitions. But my space is exhausted. Perhaps I may hereafter have an opportunity of returning to the subject—not to dogmatise upon it, nor to undertake to explain away the difficulties which surround it, but to indicate the considerations which, as it appears to me, should be applied to the investigation of such matters by those who wish to give a reason for the belief that is in them.

At present I must be content with indicating the general interpretation of coincidences which appear very remarkable, but which nevertheless cannot be reasonably referred to special interpositions of Providence. The fact really is that occasions are continually occurring where coincidences of the sort are *possible*, though improbable. Now the improbability in any particular case would be a reasonable ground for expecting that in that case no coincidence would occur. But the matter is reversed when a great multitude of cases are in question. The probable result then is that there *will* be coincidences. This may easily be illustrated by reference to a question of ordinary probabilities. Suppose there is a lottery with a thousand tickets and but one prize. Then it is exceedingly unlikely that any particular ticket-holder will obtain the prize—the odds are, in fact, 999 to 1 against him. But suppose he had one ticket in each of a million different lotteries all giving the same chance of success. Then it would not be surprising for him to draw a prize; on the contrary, it would be a most remarkable coincidence if he did not draw one. The same event—the drawing of a prize—which in one case must be regarded as highly improbable, becomes in the other case highly probable. So it is with coincidences which appear utterly improbable. It would be a most wonderful thing if such coincidences did not occur, and occur pretty frequently, in the experience of every man, since the opportunities for their occurrence enormously outnumber the chances against the occurrence of any particular instance.

We may reason in like manner as to superstitions. Or rather, it is to be noted that the coincidences on which superstitions are commonly based are in many instances not even remarkable. Misfortunes are not so uncommon, for instance, that the occurrence of a disaster of some sort after the spilling of salt at table can be regarded as surprising. If three or four persons, who are discussing the particular superstition relating to salt-cellars, can cite instances of an apparent connection between a misfortune and the contact of salt with a table-cloth, the circumstance is in no sense to be wondered at; it would be much more remarkable if the contrary were the case. There is scarcely a superstition of the commoner sort which is not in like manner based, *not* on some remarkable coincidence, but on the occasional coincidence of quite common events. It may be said, indeed, of the facts on which nearly all the vulgar superstitions have been based, that it would have amounted to little less than a miracle if such facts were not common in the experience of every person. Any other superstitions could be just as readily started, and be very quickly supported by as convincing evidence. If I were to announce to-morrow in all the papers and on every wall that misfortune is sure to

follow when any person is ill-advised enough to pare a finger-nail between ten and eleven o'clock on any Friday morning, that announcement would be supported within a week by evidence of the most striking kind. In less than a month it would be an established superstition. If this appears absurd and incredible, let the reader consider merely the absurdity of ordinary superstitions. Take, for instance, fortune-telling, by means of cards. If our police reports did not assure us that such vaticination is believed in by many, would it be credible that reasoning beings could hope to learn anything of the future from the order in which a few pieces of painted paper happened to fall when shuffled? Yet it is easy to see why this or any way of telling fortunes is believed in. Many persons believe in the predictions of fortune-tellers for the seemingly excellent reason that such predictions are repeatedly fulfilled. They do not notice that (setting apart happy guesses based on known facts) there would have been as many fulfilments if every prediction had been precisely reversed. It is the same with other common superstitions. Reverse them, and they are as trustworthy as before. Let the superstition be that to every one spilling salt at dinner some great piece of good luck will occur before the day is over; let seven years of good fortune be promised to the person who breaks a mirror; and so on. These new superstitions would be before long supported by as good evidence as those now in existence; and they would be worth as much, since neither would be worth anything.

## THE PATENT ACT OF 1883.

By Polyglot.

(*Continued from page* 326.)

YOU will next have to resolve whether you will file what is called a "provisional specification" first, and a "complete" subsequently, or a "complete" in the first instance. I will describe both procedures and advise the first. The why will appear by-and-by.

The provisional specification (to be filed in duplicate) must be a clear, concise, and fair statement, sufficient to enable any person skilled in the art or trade to which the invention relates to identify the invention, but not necessarily to practise it. If the invention relates to a machine or the like, drawings may be furnished, but are not essential; if to a chemical compound, proportions need not always be given, nor is it always necessary, when several similar substances may be used, to specify them all; a generic name, such as "an alkali" or "a resinous material," will often be sufficient *unless* the invention consists just in the use of *one* such substance where *others* have previously been used. Supposing, for instance, that you employ a chloride of sodium where chloride of calcium has been used before, and that this is the gist of your invention, then it will not do merely to say "an alkaline chloride," as this is too vague to meet the case. In doubtful cases it is preferable to make your statement needlessly full to making it unduly meagre. An important consideration is, that nothing that does not appear in the provisional specification can ultimately be claimed, though you need not afterwards claim the whole subject-matter of your description.

Above all, do not endeavour, either in the provisional or in the complete specification, to hide the nature of your invention by dubious or ambiguous wording. A fair and honest description in plain words is requisite, nay, essential. If you acquire a piece of ground, and have a map annexed to the title-deed, you will insist upon it that the map shall clearly define the territory that is to be yours; and so will your neighbours, lest quarrelling should ensue. The specification is the map which defines the ground to be covered by your patent. Lenient as courts as a rule are, and almost tenderly careful of the rights of an honest inventor, they have a way of most mercilessly "coming down" upon a man who shows a disposition to trickery in the matter.

When your declaration is ready and declared to before a magistrate, a justice of the peace or a commissioner to administer oaths (a solicitor), or, if you are not in England, before an English consular officer, you will send it and your specification to the patent office. The declaration must be stamped with a £1 stamp, and it is of no use to send money instead. If your documents are informal or otherwise wrong, the patent office will call upon you to amend them. If they are all right, the patent office will notify you of their acceptance. The office, however, takes no responsibility upon itself, the acceptance only means that the papers seem in order, but, nevertheless, your invention may be old, bad, futile, or irrevelant, or your specification insufficient to protect you, without your having any redress against the office. If, however, at the time at which your application is before the office another similar invention is brought in, or is embodied in an earlier specification, the office will notify both applicants, but will not tell either in what the other's inventions consists. This can only be found out at the opposition stage, of which more anon.

When the provisional specification has been accepted, you may, if you chose, at once file your complete specification, but are not bound to do so until nine calendar months from the date of application—that is, from the day on which your application was filed.

The complete, like the provisional, must be in duplicate; whilst, however, the provisional bears no stamp, one copy of the complete specification must bear a £3 impressed stamp.

The complete specification must fully set forth what the invention consists in, and in what manner it may be carried into practice. It must be accompanied by drawings—if these are required—to render the invention fully intelligible, and it must in every respect be a fair, true, and ample statement, enabling any one who is conversant with the trade or art to which the invention relates to practise it without any guide beyond ordinary skill, plus the specification. This does not mean that in a machine, for instance, all the strains must be calculated and the dimensions of the several parts laid down; or, for instance, in a patent for making paper it would be sufficient (if in accordance with fact) to say that the pulp is to pass through a "knotter," as every papermaker is supposed to know what a "knotter" is. The main object must be not to omit any fact that is material to the proper understanding of what the inventor really does for the purpose of attaining that result which he seeks to accomplish. To make elaborate statements about how much profit can be made by using the invention, about the beauty of its effect, or, as one or two over-fervent enthusiasts have done, to describe how wife and children "took it," is worse than useless. If you want to give a cook a recipe for a pudding, you do not begin with a lecture upon the chemical changes produced in wheaten flour by panification. Likewise, a specification must not be a treatise, only a full and honest description.

It is wisest to make the complete specification an amplication of the provisional, adding such slight amendments in the invention as practice may have proved desirable. And this possibility of adding or amending is the reason why it is best at first to file a provisional only. Because, though no essential feature must be altered or added, yet trifles go so far in making or marring new inventions, that

in the period intervening between the filing of provisional and complete, details may be devised which are likely greatly to increase the utility of the invention; and, if the provisional be well drawn, much can be introduced and validly covered by the same patent that would otherwise require a new patent; or sometimes even, if omitted would render the whole nugatory.

To make that which is new intelligible, it is in the majority of cases necessary to describe much that is old. Photography being an art well known to many, I will draw upon it for an illustration. We may assume that some one invents yet another new focussing arrangement. It is obviously desirable to describe the whole camera, and to show how the new gearing is combined with the old parts. There is no need to expatiate on the focal length of the lenses or on the size of the tripod, but probably the bellows-body, the back, and other parts will have to be mentioned and shown by drawings, and each piece of which the new motion consists must be described. To enable any one to render himself an account of what is supposed to be new, one or more "claims" are appended to the description.

Claims are a specific statement indicating precisely what is new. Say the focussing gear above spoken of consists of a rack, a slotted guide, and a toothed wheel, with a thumb-screw, then the claim might read somewhat as follows:—"I claim the focussing gear for a photographic camera, consisting of a rack, a slotted guide, and a toothed wheel with a thumb-screw, all substantially as described and shown in the drawings."

*(To be continued.)*

## THE ROTATION PERIOD OF MARS.

WE quote the following letter from *Nature* for May 15, chiefly for the purpose of replying to it, and correcting statements based on incomplete information:—

"Notwithstanding his comparatively small diameter and slow axial motion, the planet Mars affords special facilities for the exact determination of the rotation period. Indeed no other planet appears to be so favourably circumstanced in this respect, for the chief markings on Mars have been perceptible with the same definiteness of outline and characteristics of form through many succeeding generations, whereas the features such as we discern on the other planets are either temporary atmospheric phenomena or rendered so indistinct by unfavourable conditions as to defy lengthened observation. Moreover, it may be taken for granted that the features of Mars are permanent objects on the actual surface of the planet, whereas the markings displayed by our telescopes on some of the other planetary members of our system are mere effects of atmospheric changes which, though visible for several years, and showing well-defined periods of rotation, cannot be accepted as affording the true periods. The behaviour of the red spot on Jupiter may closely intimate the actual motion of the sphere of that planet, but markings of such variable, unstable character can hardly exhibit an exact conformity of motion with the surface upon which they are seen to be projected. With respect to Mars the case is entirely different. No substantial changes in the most conspicuous features have been detected since they were first confronted with telescopic power, and we do not anticipate that in future ages there will be any material difference in their general configurations. The same markings which were indistinctly revealed to the eyes of Fontana and Huyghens in 1636 and 1659, will continue to be displayed to the astronomers of succeeding generations, though with greater fulness and perspicuity owing to improved means. True there may possibly be variations in progress as regards some of the minor features, for it has been suggested that the visibility of certain spots has varied in a manner which cannot be satisfactorily accounted for on ordinary grounds. These may possibly be due to atmospheric effects on the planet itself, but in many cases the alleged variations have doubtless been more imaginary than real. The changes in our own climate are so rapid and striking, and occasion such abnormal appearances in celestial objects that we are frequently led to infer actual changes where none have taken place; in fact, observers cannot be too careful to consider the origin of such differences and to look nearer home for some of the discordances which may have become apparent in their results.

"The rotation period of Mars has been already given with so much precision that it may seem superfluous to rediscuss the point, but it is very advisable to see whether recent observations confirm the values derived from former results. The 'Hour-glass' or 'Kaiser Sea,' which is admittedly the most prominent mark on the planet, is a very suitable one for comparisons to find the intervals of rotation. Early in 1869 I saw it with a 4¼-inch refractor as it passed the central part of the disk. On Feb. 2, 1869, it was central at 10h., on Feb. 4 at 11h., and on Feb. 5 at 11h. 30m.

"I observed the same object in February of the present year with a 10-inch reflector (power 252), and noted it crossing the planet's central region at the following times:—

| 1884 | h. m. |
|---|---|
| Feb. 14 | 5 55 |
| „ 15 | 6 35 |
| „ 19 | 9 5 |
| „ 22 | 11 4 |

I have combined my observation of February 4, 1869, with that of February 14, 1884 (as I regard this pair as the best obtained), to ascertain the rotation period. The interval includes 5,487d. 18h. 55m. = 474,144,990 seconds. Correcting this for the difference in longitude between Mars and the earth at the two epochs and for defect of illumination (there is no necessity to apply any correction for equation of light, as the apparent diameter of the planet on the dates selected for comparison was about 16", and hence the distances were nearly the same), I find the time of rotation resulting from the discussion of these observations to be

h. m. s.
24 37 22·34 (5,349 rotations),

which is in satisfactory agreement with the periods computed by Kaiser, Schmidt, and Proctor from a much longer series of observations. In order to exhibit the small difference between the period now computed and those resulting from some of the best modern determinations, I give the following summary:—

| | h. | m. | s. | |
|---|---|---|---|---|
| J. H. Mädler ... | 24 | 37 | 23·8 | 'Ast. Nach.' 349. |
| 1864, F. Kaiser ..... | 24 | 37 | 22·62 | 'Ast. Nach.' 1468. |
| 1866, R. Wolf ..... | 24 | 37 | 22·9 | 'Ast. Nach.' 1623. |
| 1869, R. A. Proctor... | 24 | 37 | 22·735 | 'Mont. Not.' vol. xxix., p. 232. |
| 1873, F. Kaiser ..... | 24 | 37 | 22·591 | 'Annalen der Leidene Sternwarte,' vol. iii., p. 80. |
| 1873, J. F. J. Schmidt | 24 | 37 | 22·57 | 'Ast. Nach.' 1965. |
| 1884, W. F. Denning | 24 | 37 | 22·34 | |

It is obvious that Mädler's period of 24h. 37m. 23·8s. is about one second too great. If we take a mean of the other six values (all within 0·6s. of each other) we get

h. m. s.
24 37 22·626

which may be fairly regarded as a very near approximation to the true sidereal rotation period of Mars.

"The computations of Kaiser, Schmidt, and Proctor are severally based on very long periods, the comparisons being modern observations with those of either Huyghens or Hooke during the last half of the seventeenth century. It is unfortunate, however, that there is some question as to the correct identification of the spots depicted in some of the ancient drawings. The representations by Hooke on March 2, 1666 (old style), at 12h. 20m. and 12h. 30m., also those by Huyghens in 1659, 1672, and 1683 give a large irregular spot, extending in a north and south direction, which can only be identified as the 'Hourglass' or 'Kaiser Sea.' It would appear, however, that this interpretation is incorrect in certain cases, for the several drawings do not only show disagreements with each other, but also when compared with modern observations originate discordances of period, small it is true, but still too large to be attributed to simple errors of observation. No doubt the period which approaches nearest to the truth will become apparent from future observations, though it can hardly admit of definite settlement for many years, inasmuch as the differences between the several times of rotation as above deduced are very insignificant, and must so closely accord with the real period of the planet that the errors such as exist must be allowed to accumulate over a lengthened interval before they will become distinctly manifested. A comparison extending over fifteen years is insufficient for the purpose, for a computed time of rotation, erroneous to the extent of one-tenth of a second, will still, at the termination of such a period, answer to the positions of the markings to within nine minutes of time. It

is to be remarked that Mr. Marth, whose opinion is entitled to great weight, has, for some time, adopted the period of 24h. 37m. 22·626s. for the rotation of Mars. This corresponds to a daily rate of 350°·8922, and forms the basis of his computations on his 'Ephemerides for Physical Observations of Mars,' annually published in the 'Monthly Notices.' W. F. Denning."

[Mr. Denning omits to notice that in a paper contributed to the proceedings of the Astronomical Society in 1873 I indicated errors if computation in Prof. Kaiser's treatment of the long period between Huyghens in 1659 and Kaiser's own observations in 1864 and later. Kaiser appears to have counted the years 1700 and 1800 as leap-years, and to have made a further mistake as to the effect of change of style. When correction is made for these errors —as to the reality of which no question can exist (for Kaiser indicates the number of days he counted in the long period, and they are three too many) his value of the rotation-period is changed into a value practically identical with mine. For each day counted in error caused an extra Martian rotation to be counted, giving in all three rotations of Mars over the right number, and the difference, between three Martian days and three terrestrial ones,—or three times 37m. 23s.,—has to be divided among nearly 89,000 rotations —giving ·076 sec. to be added (obviously) to Kaiser's value. This gives 24h. 37m. 22·7s. (I have long since given up the idea that the second decimal figure can be given.) Prof. Newcomb, of Washington, told me in 1874 he had checked my examination of Kaiser's computation, and found it correct.

Mädler's period, a second too long, shows how little reliance can be placed on observations covering only ten or twelve years or so. Mr. Denning's value is a marvellously good shot for so short a range in time as he employed. But it cannot (from the nature of the case) enter into competition with any of the long-distance ones. The mean of the other long-distance values (Wolf's and Schmidt's) is, oddly enough, 24h. 37m. 22·735, exactly that which I gave in 1869. But as I have said, all I would now maintain is that the value is 24h. 37m. 22·7 sec.,—that is, that the seconds lie between 22·65 and 22·75.

Mr. Marth probably adopted his fellow-countryman's estimate (Kaiser's in 1864), and not having followed later inquiries, has failed to notice the errors discovered in Kaiser's computation. I am not aware that he has independently examined the matter at any time.

Oxford, May 17. Richard A. Proctor.]

## THE FACE OF THE SKY.

From May 23 to June 6.

By F.R.A.S.

Malgré the passage of (what we may call) the official spot-maximum, beautiful groups continue to appear upon the surface of the Sun. The aspect of the night sky may be gathered from Map VI. of "The Stars in their Seasons." There is, however, no real night at all now in the British Islands. Mercury is a morning star, and about the time that these notes terminate may be caught above a point of the horizon between E. by N. and E.N.E., just before sunrise. Venus is now by far the most brilliant and conspicuous object in the sky, and her crescent forms an object of daily-increasing size and beauty in the telescope. Mars, Jupiter, Saturn, and Neptune have left us for the season; but Uranus may be picked up to the west and north of $\beta$ Virginis (Zodiacal Map, p. 165). He must, though, be looked for the moment the twilight deepens sufficiently. One occultation of a star only is visible during the next fortnight. It occurs on May 30, when 16 Sextantis, a 6th magnitude star, will disappear at the Moon's dark limb at 10h. 19m. p.m. at an angle of 112° from her vertex. It will reappear from behind her bright limb at 11h. 17m. p.m. at a vertical angle of 285°. At noon to-day the Moon is in Aries, out of which constellation she passes into Taurus about half-past two o'clock to-morrow morning. It is not until 10 a.m. on the 26th that she enters the northern strip of Orion, which is conterminous with Taurus and Gemini; travelling through it in some 11 hours, and about 9 p.m., crossing its eastern boundary into Gemini. She remains in Gemini until 10 a.m. on the 28th, at which hour she enters Cancer. She quits Cancer for Leo at 11 o'clock on the night of the 29th, through which latter constellation she travels until at 1 a.m. on the 31st, when she descends into Sextans, re-emerging in Leo at 5 o'clock the same afternoon. She crosses from Leo into Virgo at 7 o'clock in the evening on June 1st, and her passage across this great constellation occupies until 5 a.m. on the 5th. At that hour she quits Virgo for Libra, where she remains until 6 a.m. on the 7th.

## Reviews.

### SOME BOOKS ON OUR TABLE.

*Biogen. A Speculation on the Origin and Nature of Life.* By Professor Elliott Coues. (London: Trübner & Co. 1884.)—Here is the old scholastic figment of a "vital principle" warmed up again, after we fondly imagined that it was still and cold for ever. Why a vital principle should be more needed to account for the phenomena of life than, say, a "watch principle" for the movement of the seconds-hand of a watch, Mr. Coues does not condescend to inform us. He also is good enough to tell us that he *feels* that so-and-so is true; ergo it must exist. But Mr. John Hampden feels that the earth is as flat as a pancake, and a visit to Hanwell or Colney Hatch would reveal the existence of numerous gentlemen who each feels that he is the prophet Habakkuk, or a glass bottle, or the Rumtifoozle, as the case may be. While appreciating the spirit and feeling which have prompted the utterances of Professor Coues, we cannot congratulate him on his contribution to science.

*A Lump of Iron. From the Mine to the Magnet.* By Alexander Watt. (London: A. Johnston. 1884.)—A popular and well-written account of the most important of the metals in all its aspects—mineralogical, metallurgical, and mechanical. The processes of smelting, ironfounding, steel-making, &c., up to the conversion of the steel into a magnet, are described in the clearest possible way; there is an interesting chapter on meteorites, as the source of meteoric iron; and a kind of appendix of interesting notes on matters connected with the subject of the book. Mr. Watt's little volume is well worth buying. It is news to us that a piece of wrought-iron was taken out of an inner joint of the Great Pyramid forty-seven years ago. This carries its use back to a very remote age indeed.

*Experimental Proofs of Chemical Theory for Beginners.* By Wm. Ramsay, Ph.D. (London: MacMillan & Co. 1884.)—This really excellent little manual contains a series of exercises in quantitative analysis calculated to familiarise the beginner with the methods and results of the most recent developments of chemical science. Illustrations of every one of the pieces of simple apparatus required are given, together with explicit directions for their manufacture by the student himself. The twelve chapters of which the work consists treat successively of the Measurement of Temperature Pressure and Weight, the Relation of the Volumes of Gases to Temperature and Pressure, Air, Hydrogen Chloride, Water, Ammonia, Atoms and Molecules, Quantivalence, Equivalents of Metals, Specific Heat, "Replacement," and the Periodic Law. Dr. Ramsay's small volume will, doubtless, become a popular text-book in the laboratory—as it deserves to be. We note by the way a little slip or omission on p. 4, where it is stated that, in reading a thermometer, "if the eye is too high the temperature registered will be in excess of the real one," and *vice versâ*; the fact being that this depends upon whether the graduations are between the mercury and the eye—or (as is generally the case) behind the quicksilver. In the latter case an elevation of the eye seemingly *depresses* the mercury and makes the instrument read too low.

*The Periodic Law.* By John A. R. Newlands. (London: E. & F. N. Spon. 1884.)—"If," says Dr. Ramsay, "the elements be arranged in the order of their atomic weights in eight vertical rows, they fall into natural classes, each class containing elements resembling each other in the

nature of their compounds, and in their usual valency." As both Mendelejeff and Lothar Meyer have received more or less credit for this discovery, Mr. Newlands makes a reclamation on his personal behalf in the work now before us, and shows incontestably, by reference to dates, that his own detection of the so-called "Periodic Law" was made in 1864. This and his researches on the atomic weights generally make up a volume, which is sure to be soon found in every chemical library.

*About Photography and Photographers, &c.* By H. BADEN PRITCHARD, F.C.S. (London: Piper & Carter. 1883.)—This chatty and readable series of short papers and essays seems eminently calculated to develop a taste for photography in any one and every one who may come across it. It may be opened at random, with the certainty of coming across something amusing: for the amateur, the professional photographer, the artist, the sitter, and the tourist will one and all find matter to interest him.

*A Popular Treatise on Modern Photography.* By GEORGE DAWSON, M.A. (Glasgow: George Mason & Co.)—The reader whom Mr. Pritchard may have filled with a burning desire to commence practical photography forthwith, could scarcely do better than lay out a shilling in Mr. Dawson's pamphlet. It contains the plainest and most explicit directions how to operate both by the wet and dry processes; explaining to the student in the minutest detail not only what to do, but—which is often of equal importance—what *not* to do. It is a capital little book.

*The Early Days of the Human Race.* By T. FREDERICK J. BLAKER, M.R.C.S. (Brighton: H. & C. Treacher.)—Mr. Blaker tells the story of ancient man in a simple and agreeable way, and his little book may be read, not without profit, as an introduction to larger and more pretentious works on the subject.

*Science in the Nursery, or Children's Toys and what they Teach.* (London: Griffith & Farran.)—What Dr. Paris did in the days of our grandfathers in his "Philosophy in Sport made Science in Earnest," in connection with toys in vogue during the earlier part of the century, Mr. Erle has essayed to do with regard to those with which the present generation is amused. He tells us in his introduction that his work is a reproduction of a series of lectures addressed "to a rural audience." If this be so, we can only fear that our author's expositions must have gone clean over the heads of his hearers. His science is perfectly sound, and his descriptions of the mechanical and optical principles upon which many of our common toys are constructed leave nothing to be desired—except that the language in which they are conveyed should be a trifle less "fine." Opening the book absolutely at random, we read (p. 288), apropos of "dynamical friction," "It is either shifted over to the particles of the medium, or surfaces, which environs or touches the line of march, producing among them a certain amount of dislocation of arrangement, or, if displacement be more or less successfully resisted by them, then motion to the same amount reappears as its *alter ego*, that is to say, in its other phase of heat." It would be curious to speculate how much of this sort of thing would be assimilated by a gentleman of the agricultural persuasion who had spent his day turnip-hoeing or tan-flaying.

*The House of Lords.* By SIR JOHN BENNETT.—Save in its sociological aspect, the subject of this funny little tract is rather beyond our scope. Certainly the ex-sheriff does not spare the hereditary Chamber of Legislators, and his *exposé* of that most pitiful and contemptible race the Stuarts, and the contrast he draws between them and Oliver Cromwell is not without historic interest. Somehow, though, we imagine that the House of Lords will last for our time.

## PLEASANT HOURS WITH THE MICROSCOPE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

THE wings of insects do not correspond with the anterior extremities of any of the vertebrate animals. Their function of beating against the air to produce the motion of flight is, indeed, the same as that of the wings of the bird, but they are not, like those organs, modifications of fore-limbs. If, as is probable, the earliest insects were inhabitants of the water, some of them would be supplied with external gills, and by successive changes these organs would be modified so as to suit terrestrial life, and, finally, serve for flight. External breathing organs are common in the larval forms of many water insects. They are well furnished with tracheal tubes, and this is the case with the wings of flies, bees, &c., which have been called aërial gills. These tracheal tubes are made firm and hard by deposits of a chitinous material like that of the hard skin and elytra of beetles, and their use as strong supports of the delicate wing membranes has led to their being named *Pterigostia*, or "wing bones." Mr. Newport remarked that there appears no part of the body in vertebrata analogous to the wings of insects, except, perhaps, in the single instance of one of the Saurian reptiles, *Draco volans*, in which a pair of supernumerary organs to assist in locomotion are developed from the sides of the body, and which are formed by the ribs, directed horizontally outwards, and covered over by the skin. In insects that are good fliers the supply of nerves to the wings is very considerable, and so arranged as to produce a perfect co-ordination of their motions.

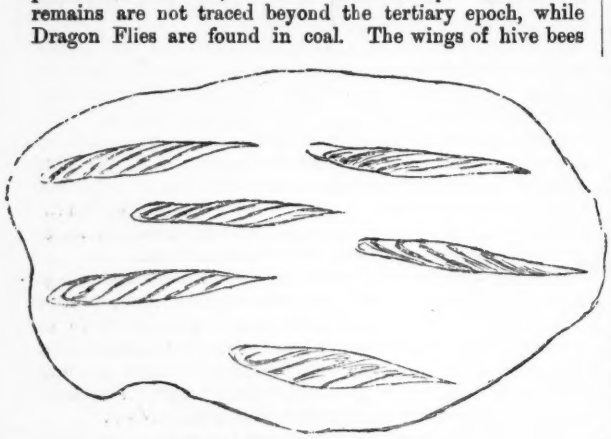
Having thus reached the conclusion that the wings receive many nerve fibres and many tracheal tubes, we may expect that some part of their structure is likely to be connected with sensations, and in the various kinds of flies, bees, wasps, &c., it is probable that some of their peculiar hairs or bristles may receive and transmit vibrations useful to the creatures in avoiding obstacles in their flight.

Between spring and autumn many two-winged insects of grey and blackish hue frequent our houses, and settle on the windows. Few persons notice much difference, except in their sizes, but they comprise several species. All, however, that I have examined have wings covered with a multitude of minute hairs, of simple structure, and springing from a little bulb. The outer rim of the wings exhibits another kind of hair or bristle, and near their base there are long porcupine-quill-like bristles, which, viewed as opaque objects, with a magnification of 200 or 300 linear, are seen to be beautifully fluted. Further down the wing towards the tip, the long bristles cease, and stumpy conical ones appear, also multiple fluted. Each one of these, both long and short, seems capable of motion, as the way they spring out of the bulb bears some resemblance to a ball and socket joint. Near the tip of the wings these stout bristles cease, and on the inner side of the wing there are none, but a fringe of fine delicate hairs, longer than those thickly scattered over the wing membrane. The short bristles may possibly transmit vibrations like the whiskers of a cat. The multitude of small hairs scattered all over the wings must, as they stand out, give the organ a grip upon the air as they strike it slantingly. Their bulbs must also tend to prevent any accidental rent or rift in the thin membrane from extending, and thus they add to its strength.

I am not aware that any one has made a study of these hairs in different orders and genera of insects, but it might repay the trouble. The most curious difference I have

noticed occurs in wasps. The wings of this insect are dotted over with hairs, which a lady to whom they were shown likened to a shoal of little fishes. They are of various sizes, some thin and some stout; but all agree in having a number of ribs making a diagonal pattern, as shown in the annexed sketch. These hairs are not arranged as regularly as those on the wings of a house-fly, and do not show their structure without careful illumination. The bristles on the outer edge of the house-fly's wing have their ribs or grooves arranged lengthwise, and as nearly parallel to each other as their tapering form permits. The wasp wing hairs have their ribs starting from about equal distances all down their sides, which suggests a spiral arrangement. The membrane of this wing is so transparent as to be scarcely visible between the hairs and nervures.

Is the structure of these hairs a modification tending towards butterfly scales? No answer can be given to this question without extensive observations. The wasps are, structurally, in advance of common flies, and Haeckel regards the Lepidoptera—butterflies and moths—as the most perfect class of flies, and the last to develop. Their fossil remains are not traced beyond the tertiary epoch, while Dragon Flies are found in coal. The wings of hive bees



Hairs on Wasp's Wing, × 870.

and hornets do not possess these peculiar hairs. Some of the broadest of the wasps' might almost be called scales; but they have not the quill-like beginnings of the butterflies' plumes, nor are they inserted into similar cavities or sheaths. As all sorts of flying insects will abound in the coming summer, there will be good opportunities for noticing what modification of hairs their wings can show, and if any of my readers become possessed of a new fact, I shall be obliged by an early notice of it.

With reference to the probability that wings were developed from external tracheæ, Sir John Lubbock observes, "That wings may be of use to insects under water, as proved by the very interesting case of *Polynema natans*, which uses its wings for swimming. This, however, is a rare case; and it is possible that the principal use of the wings was, primordially, to enable the mature forms to pass from pond to pond, thus securing fresh habitats, and avoiding in-and-in breeding."

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The Panama Canal.—It is affirmed that of 90,000,000 cubic mètres of earth which have to be excavated from the Panama Canal, only 2,500,000 cubic mètres had been removed up to October, 1883. In that month more than 10,000 men were employed on the work. It is now proposed to increase the working force to 15,000 men, and it is expected that with better weather the extraction will be materially increased. It is still hoped that the canal will be inaugurated in 1889.

# THE ENTOMOLOGY OF A POND.

By E. A. Butler.

OUR aquatic insect fauna is both extensive and interesting. The habits are varied and the forms peculiar, in consequence of the structural modifications rendered necessary for their adaptation to an aquatic mode of life. They can, moreover, be easily studied, even in the home, by help of suitable aquaria, and, hence, we hope that a few papers devoted to their consideration may be not unacceptable. The insect inhabitants of a pond constitute tolerably well-defined groups, differing according to the area of their distribution. You find one set almost exclusively on the surface, which they rarely leave either for excursions into the depths below or the air above; another in the middle depths, where they disport themselves in all directions, occasionally also visiting both top and bottom, and even escaping upwards into the rarer element; another on the bottom, where they grovel amongst the mud; another, again, round the margin, where, like children at the seaside, they dabble about in the wettest parts, and even let the tiny ripples play on their very feet; and yet another, gracing with their presence the air above the pond, scudding about in search of the two great desiderata of an insect's life, food and mates. We will first turn our attention to

## The Surface.

The fauna here is almost exclusively Hemipterous, consisting of bugs belonging to the remarkable section *Hydrodromica*, or Water-measurers. These curious beings will have attracted the attention of even the most unobservant. Blackish spider-like creatures floating on the surface, and jerking themselves rapidly along by vigorous strokes of their long thin legs, leaving little rippling eddies behind them, they will have excited wonder by the apparent impossibility of their submersion, and by the confidence with which, therefore, they trust themselves to what is, to most creatures, the treacherous element. It is not easy to catch them; they are wary and shy, and can calculate with considerable exactitude the area of pond surface that can be covered by the water-net of the expectant biped on the bank, whom they seem to take a delight in tantalisingly watching from just outside the charmed circle. Let him hide behind a bush and wait till they appear on the other side, and then come round with a dash and a swoop of the net—they are equal to the emergency, and before the weapon can reach the surface, a few bold strokes of those long slender legs have carried them in an instant out of harm's way.

Cautious attempts, however, after a time result in the enclosure in the net of some stray individuals less wary than their fellows; but even then their ultimate capture is not a foregone conclusion—those same spindleshanks come to their assistance again, and, unless their would-be captor is vigilant, with a few bold leaps they will be out of the net, and hopping off in all haste through the grass to the water, which, once reached, they will sail gaily away. Suppose, however, we have managed to secure a specimen of the commonest species, *Gerris lacustris* (Fig. 1). Let us proceed to examine it. It is a blackish creature, with an orange edge to its narrow body, and a little over ⅓ inch in length. The head is prolonged into the customary beak, characteristic of the Hemiptera, bent back as usual underneath the body. The wings lie so closely along the back as almost to escape observation, but if we can manage to open them, we find that the upper pair are opaque and tolerably stout, but the under pair thin, membranous, and semi-transparent. They are very neatly packed away, and the upper pair overlap at their

tips. Turning the creature over on its back, we notice that underneath it is closely covered with tiny hairs, which in certain lights shine like polished silver, but in others appear of a dull grey. The legs are six in number, but the antennæ, lying close to the front pair, and almost equalling them in size, give the insect the appearance of having eight legs, like a spider; the front pair are short and rest upon the water at their tips, being extended beyond the head, where they are extremely useful in securing prey; the second pair are much the longest and constitute the rowing organs—they are slender, and look like stiff bristles bent twice at an angle; the third pair are similarly constructed, but, being shorter, do not in any way interfere with the powerful strokes of the others, and are used as rudders.

The attachment of the rowing legs to the body, instead of being placed underneath, as is almost universally the case with insects, is thrown well out at the sides, a peculiarity which enables the little rower to use its muscular power to the best advantage. The general appearance of the creature is not particularly attractive; in addition to the dinginess of its colour, the various modifications of its limbs give it, when off the water, an ungainly aspect, which seems to suggest that the owner of such slender appendages must have an anxious time of it to guard them from fracture; but Nature is always prepared to sacrifice elegance and symmetry for the sake of utility. A close inspection, however, reveals many points of beauty besides the silvery hairs, notably some coppery scales, dotted here and there over the upper surface. The eyes are prominent, and no doubt give their possessor a wide range of vision, which it greatly needs, for, living as it does at the junction of two media, it is exposed to the attacks of foes in the air above and in the water beneath.

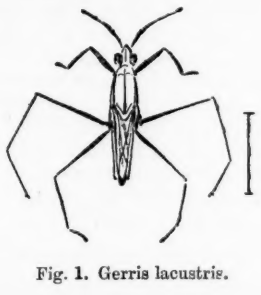


Fig. 1. Gerris lacustris.

The Gerridæ live by sucking the blood of other insects, which they can catch by pursuing and leaping upon them. Even on the water they possess considerable saltatorial power, and when themselves fleeing from their persecutors, if the ordinary rowing does not effect their escape with sufficient rapidity, they will expedite their flight by a few wild leaps.

Ten species of the genus inhabit the fresh waters of the British Isles, two of them occurring only in Scotland. The largest kinds can with fully outstretched rowing legs cover a width of $2\frac{1}{4}$ in. of water, and are gifted with proportionately rapid powers of locomotion. Like most of the Hydrodromica, all the genus are gregarious, scores of the smaller kinds being often seen dotting the surface of a suitable corner of a pond. Insects somewhat similar are known to exist on the surface of the sea, out in mid-ocean, where, hundreds of miles from land, they spend their whole lives. It is curious how very few insects proper are associated with salt water, though the fresh-water fauna is abundant.

Closely allied to the Gerris group, but differing considerably in appearance and method of locomotion, is the strange insect named *Hydrometra stagnorum* (Fig. 2). This is one of the narrowest of all British insects, and reminds one of the exotic "walking-stick insects" on a small scale: its legs are as fine as hairs, and even its body, with a length of half-an-inch, does not exceed, at its widest part, one-twenty-fourth of an inch in diameter. It does not jerk itself along after the manner of a Gerris, but actually walks or runs upon the surface of the water; it is most frequently found close to the margin of the pond, where it alternates between land and water, equally at home on both. In consequence of their extreme slenderness, they easily escape detection, and half-a-dozen may be walking on the water, just under one's eyes, without being noticed at all.

Fig. 2. Hydrometra stagnorum.

This insect exemplifies a remarkable peculiarity often met with amongst the Hemiptera. It will be remembered that the progress of development in bugs is such that no quiescent pupa stage intervenes between the active larval form and the adult insect; the pupa differs from the perfect form principally in the absence of wings, and from the larva in faint indications which form a suggestion or promise of those organs. Occasionally, however, the ultimate form does not acquire wings, but remains "undeveloped," thus greatly resembling a pupa, so much so, indeed, as to have deceived entomologists again and again, until it was discovered that these apparently immature forms were sexually mature, a condition that may usually be accepted as proof that an animal has reached its ultimate state. In all orders of insects there are apterous forms, but the Hemiptera are specially remarkable in two respects, viz., that there are various degrees of imperfect development in different species, ranging from an entire absence of wings to their perfection in all but some minute part, and that these conditions prevail in a large proportion of species. Out of a total of 420 species of British bugs, about 60 occur more or less imperfectly developed. Species thus imperfect when mature, occasionally, from causes at present undetermined, assume in certain individuals the completely winged form, but such instances are, as a rule, rare. The present insect possesses only the merest rudiments of wings.

*(To be continued.)*

SUBTERRANEAN FISH.—A fact of much interest to students of natural history is vouched for by Cavalier Moerath, a civil engineer, formerly of Rome, and now visiting this country. This gentleman has devoted much labour and attention to the improvement of water supplies in Italy. In prospecting for water with one of "Norton's Abyssinian" tube wells, he tapped a spring from which was pumped a tiny living fish. This fish had passed into the tube well through the ordinary perforations of about $\frac{1}{8}$ inch. Examination proved it to have no eyes, clearly indicating that it belonged to an order intended to inhabit subterranean waters. The occurrence was certified to by two other gentlemen who were present when the fish was pumped up.

## Editorial Gossip.

M. PASTEUR promises us safety in future from hydrophobia,—though as yet it does not appear clear that he has established the validity of his preventive system. It appears that after being bitten by a mad dog a man or any other animal may be saved from an attack of hydrophobia by being inoculated with the virus in different degrees of strength. It is unnecessary to be inoculated before being bitten. The case is akin to that of small-pox as dealt with by an American physician, whose experiences we quoted in one of the early volumes of KNOWLEDGE. He found that the signs of an impending attack of small-pox could be recognised by the pulse; and that even after such signs had been noted it was not too late to secure safety by vaccinating the patient.

PASTEUR hopes to see hydrophobia eradicated, through the application of his system to every case in which an animal has been bitten by a rabid dog. For whatever the actual origin of the disease, it can now only be imparted by actual biting.

How great is the "glorious uncertainty" of cricket! The Australian eleven defeats in one innings an eleven including many of the finest players in England, and is presently defeated by the Oxford eleven by seven wickets. The Oxford eleven meets an eleven of the gentlemen of England regarded as only moderately strong,—and though at this writing the match is not over, it looks "all Lombard-street to a China orange" against Oxford. (A few minutes before writing these lines I saw the fifth Oxford wicket fall for 73, more than 200 runs being wanted to save the game.)

ON one occasion, when the same elevens of Eton, Winchester, and Harrow encountered each other, Eton beat Harrow in one innings; Harrow beat Winchester in one innings; and Winchester thus shown (one would have thought) to be far weaker than Harrow, which had been proved to be far weaker than Eton, beat Eton in one innings. What are the odds against such a result to the three matches? It would not be easy to say. But the nature of the problem may be thus presented. The games showed the three schools to be pretty nearly equal. The chances may be some ten or twelve to one against one of two nearly equal elevens beating the other in a single innings. Say eleven to one. Then the chance of each match ending in a single innings defeat is $1/12 \times 1/12 \times 1/12$, or $1/1728$; but the chance that the beaten eleven in the first match would be the winning eleven in the second, is only half the chance that either one or the other of the elevens in the second match will win in one innings: a similar relation holding in the third match. Hence, if the chance of a single innings' defeat in a match between two equal elevens is 1/12, the actual chance of the observed event was $1/12 \times 1/2 \times 1/12 \times 1/2 \times 1/12 = 1/6912$, or the odds were 6911 against the observed event. The coming-off of the observed event was undoubtedly a very singular coincidence.

IT may be a mere coincidence, a singular chance, that Cambridge has been singularly successful against the Australians. Thrice have Australians met Cambridge, and thrice have they been soundly beaten by the younger men —once in a single innings. Oxford now has had a turn; and let the match with Cambridge go how it will, the Universities will be one win ahead on the seven games. In the first Cambridge victory, Cambridge played without Lucas, her safest bat. Speaking of cricket chances, what are the odds against every man in an eleven making double figures? Undeterminable of course. But, has such a result ever been recorded? Last year it nearly came off. (I have long been looking out for a case.) An eleven made all double figures but one,—even double figures in the extras, and no triple figures. But one man reached nine only! Is there any recorded case where every man in an eleven made over nine and under 100, the extras being also between those figures?

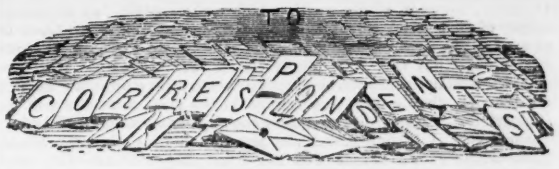
MR. YATES, editor of *The World*, thinks to show his profound acumen by ridiculing the account given by Mr. Wilson, senior wrangler in 1859, and head-master of Clifton College, and to make his ridicule more effective calls Mr. Wilson "a senior wrangler, now a schoolmaster." This sort of wit is akin to that shown by the rival editors of *Truth* and *The World* in calling each other respectively Edmund and Henry, as if the editors of *Nature* and KNOWLEDGE should deem it clever to address each other in those papers as Richard and Joseph. Mr. Yates would not find his standing much shaken were anyone to speak of him as "a novelist, now an editor," though others might regard it as no compliment to speak of him as author of Mr. Yates's novels and editor of *The World*. One is led to ask whether Mr. Yates's bludgeon was broken when he brought it down so clumsily on Buchanan, or the edge of his dagger turned when it glanced off Lord L.'s backbone. Mr. Wilson would have survived even though Mr. Yates had said of him he was only a mathematician,—for Mr. Wilson was something more than a fine mathematician even at the time to which his story relates. He was an excellent classic, a more thorough student of literature than Mr. Yates, to judge from his books, has ever been, and outside his study a good all-round man at many manly sports, as cricket, football, and rowing,—"a virtue which was never seen in" Y. Why any statement of his should not be trusted merely because he has not written (at least he has not yet published) a fifth-rate novel, or edited a paper which has been described of late as fit reading only for fools and flunkeys, is not obvious.

THE PHOTOGRAPHIC SOCIETY OF LONDON.—Last Tuesday week, at the monthly meeting of the Photographic Society in Pall Mall, Mr. James Glaisher, F.R.S., presiding, Mr. John Spiller, F.C.S., read a paper on "The Fading of Paper Photographs." He ascribes much of the fading to the presence of traces of free hyposulphite of soda in the cards and papers ordinarily sold by manufacturers, and on which the photographs are mounted. The presence of hyposulphite of soda therein, he said, is almost universal, especially in the black and highly-coloured tablets. The salt is used by manufacturers to get rid of the chlorine used in bleaching the materials. Although thirty years have elapsed since photographers made an outcry against hyposulphite of soda in ordinary papers, it is only of late that much chance of the disuse of the salt has appeared; out sulphite of soda will answer the same purpose, and at present this and several other sulphites are in course of manufacture on a large scale at Stratford for paper manufacturers. He had soaked paper photographs in sulphite of soda for forty-eight hours without their being the worse for the treatment, which was not the case when hyposulphite was substituted. In the discussion which followed, Mr. Dunmore said that he admitted that solutions of hyposulphite of soda would cause a print to fade, but in a dry state it would keep all right; he and others had tried it by experiment. Captain Abney said that the yellowing of the white and not the fading of the dark parts of photographs was the greater trouble; the organic oxides of silver did the damage, he thought. He could corroborate Mr. Dunmore's statements. Mr. Werge stated that very thorough washing of the prints after fixing, such washing as they did not always receive, had much to

do with their permanency. Another speaker said that twenty-three years ago, when he was abroad, he sent some photographs to the London International Exhibition, and was surprised to receive no award or notice; he went to Dr. Diamond about it, who asked him to go and look at his pictures; he did so, and found they had all faded. Those kept by himself had not faded, so the effect was due to something in the mounts used by the London operator to whom he sent them to be mounted for the Exhibition. Mr. W. England stated that he remembered the photographs mentioned by the last speaker; they had been suspended in a damp place at the Exhibition. Mr. Spiller, in the course of his reply, said that sodium sulphite has little power in dissolving chloride of silver, but it absorbs free chlorine. He denies that prints with or without hyposulphite of soda in them can be kept dry, because paper is hygroscopic; a sheet of paper will, therefore, gain several grains in weight in wet weather. He was only dealing with one portion of the subject that evening, and not the one mentioned by Captain Abney. Mr. W. E. Debenham then read a paper on the "Illumination of the Developing Room," and the proceedings closed.

TELEGRAPH WIRES IN NEW YORK.—The New York *Electrician* states that the winter just past has been unusually severe upon overhead telegraph wires, although no single storm has wrought the extensive damage that has been caused by the sleet and snow of previous years. The Metropolitan Telephone and Telegraph Company of New York was the most seriously affected, by reason of its immense system of light wires. A single storm caused about nine hundred interruptions, while on other occasions the derangement of the service was such that the superintendent would be willing to see the wires placed almost anywhere, even underground, if the result was otherwise satisfactory.

TRAVELLING IN ABYSSINIA.—The special correspondent of the *Daily News* with Admiral Hewett's expedition gives the following account of the country:—The next morning we entered on the most serious part of our journey, a very steep ascent of 5,000 feet. The first few miles of our route lay through very fine mountain scenery, reminding me a little of our own Highlands and a good deal of the Balkans. Birch, cedars, and acacia trees, box, and orchids covered the sides of the gorges, flowers in profusion, maiden-hair ferns and lichens brushed us as we toiled up the mountain. A few of the Abyssinian guard in front of the Admiral played upon pipes roughly made out of the bark of the trees, and the notes, very mellow and sweet, seemed to start all the birds along our route into song. Skirting for some time the side of a rocky precipice, we suddenly emerged into a valley, the aspect of which was unlike any we had yet seen. The whole foliage of the mountain seemed to change as if by magic, so unexpected a transformation from European delicacy to African crudeness was the sight of the *Euphorbia candelabra gigantica*, bursting into bloom with its clusters of red and yellow blossom, gigantic aloes in flower, and cactus parasites clinging to the rocks and trailing in great luxuriance from the trees. The sun, which had been shaded from us by the forest below, now burst out in all its fierceness, flooding the valley with a glare of light, making this Arabian Nights sort of scene, though novel, most distressing for weary travellers in search of a camping-ground. At last, where the valley narrows under an avenue of *Candelabra gigantica*, we pitched our tents and started our fires. The following day was the most trying and difficult of all our marches. The Maiensi Pass is one of the steepest routes for the passage of human beings to be found on the globe. It is absolutely impossible to ride any kind of horse up it; so we all took to mules. My horse, being led by my servant, dropped down dead at the foot of the mountain. Whether he died from sheer fright at the terrible journey before him, or by poisoned herbs he had picked up the night before, I never shall know, for my groom only brought his saddle and tail in when we arrived in camp. Poor brute! He was the only animal we lost on that rough journey. Nearing the top of the Maiensi the *Candelabra* began to disappear, and only wild olive and the box were left to crown the heights, with the exception here and there of a bush of dog-roses and some wild lavender. A horseman now came scampering down from the mouth of the pass above us, and saluting the Admiral, told him that the Ras, his master, had seen us coming, and thus early sent his greeting. Presently the route narrowed into a rocky defile, and we suddenly emerged on to the Abyssinian plateau. Immediately her Majesty's representative was sighted, the slight eminence on our right and the plateau to our left became alive with horsemen galloping towards us, and when we were well in the open more than 1,500 cavalry charged straight at our group, throwing up their spears and waving their shields. Curbing their horses a few paces in our front they careered round our flanks, bowing to the Admiral, and then formed up in an irregular line in our rear.




"Let Knowledge grow from more to more."—ALFRED TENNYSON.

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## FALSIFYING HISTORY.

[1252]—It may appear a comparatively trivial matter with which to occupy the columns of a scientific journal, but I should like to enter my protest against the persistent falsification of history which goes on in our coinage and postage-stamps, by the way in which the Queen's head is reproduced upon them. The same girl's head and face, which did duty on money coined in 1840, reappears now forty-four years afterwards without the slightest alteration in any detail. I am, I trust, too loyal a subject to presume to believe that it is merely conceit on the part of the Queen which is at the bottom of this ridiculous travestying of her features. Her age (65) may be read in every penny almanack that is sold about the streets, and hence to represent her as still about 18 is simply to insult her by the implication that she is pleased by such barefaced and fulsome flattery. Her subjects are not wholly unfamiliar with her present aspect, and know perfectly well that what purports to be her portrait upon the shilling and the postage-stamp bears much about the amount of resemblance to her at present that it does to Miss Victoria Vokes. How differently these things were managed in the days of the Queen's immediate predecessor, a glance at coinage still in circulation will suffice to show. George IV. was about as vain and conceited a man as ever lived, but he did not go to the length of being represented as a young man of two-and-twenty upon the huge five-shilling pieces which characterised the mintage of his reign. Nor did his Majesty's immediate predecessor, William IV., indulge in such empty nonsense either. The value of coins and medals to the numismatist, the archæologist, and the historian can scarcely be overestimated—always assuming that they present accurate contemporary representations of the persons whose effigies they bear; but if such effigies are not to be actual *portraits*, they become a mere delusion, mockery, and snare. The recent issue of a fresh set of postage-stamps and the proximate one of the new half-sovereign might well have been taken advantage of to give the nation a real and authentic portrait of the Queen. Is it mere red tape, or is the meanest and paltriest toadyism, which has stood in the way of this most desirable consummation?

ESSE QUAM VIDERI MALIM.

["Esse" (he will excuse my shortening his name) omits to notice that the coins and stamps he refers to will be hereafter most instructive in one important respect, though they may not show (which I venture to regard as of less importance) the appearance of the venerable old lady whom they are supposed to symbolise. Will it matter greatly if lads and lasses five hundred years hence, looking at a shilling of this day in a numismatists' collection, should fall into the mistake of imagining that the nominal sovereign of England in 1884 was a mild-looking young lady of some eighteen summers? If at that time men have so far progressed that they no longer put as an important part of education the dates of accessions and deaths of kings and queens, but consider rather those events by which the progress of the nation was really influenced, I should imagine they would hold that "the value of coins and medals to the *historian* could scarcely be *under*-estimated," so far as the particular point touched on by "Esse" is concerned. But the lesson our young-lady pictures of a lady who if I mistake not has been for several years a great-grandmother, will teach about the ways of certain classes in these our times, will be instructive, and, I should imagine, rather impressive five hundred years hence. Some Herbert Spencer of the future will therein find

evidence, I expect, of the way in which men may rise "on stepping-stones of their dead selves to higher things" (for this we trust is as true of the race as of the individual). No one I should suppose can doubt what this silly bit of flattery really means. Nor can any one who notes the development of sense and manliness among us question that a few generations hence such nonsense will be impossible. I venture to suggest some slight doubts as to "Esse's" chronology. I labour under the impression that the immediate predecessor of the queen was the exemplary William IV., who left no son to succeed him, though a dozen sons and daughters were born to him—the genial "sailor-king" of 1830–1837, who after 1837 is pictured in the narrative of those who had bowed before him and flattered him during life, as a half-crazed boor of most ungenial nature. His immediate predecessor was the still more exemplary George IV., of whom Englishmen did not hesitate to call themselves "loyal subjects," degrading the noble word "loyal" to a most ignoble use, and describing themselves by a word which for my own part I would no more apply to myself (let the law call me what it pleases) than I would call myself a slave when I knew I was none.—R. P.]

## THE GRAND CAÑON.

[1253]—I believe Sir C. Lyell has given 30,000 years as the time it has taken the Falls of Niagara to recede about six miles from their original position. I have some grounds for supposing the same period has been occupied by the Colorado river in cutting the channel or ravine called the Grand Cañon. As you are doubtless aware, this gorge is cut through 4,500 feet of sedimentary deposit, and then 1,000 feet into the granite. I should like to ascertain whether any estimate of the time it has taken the Colorado river and its tributaries to cut these deep gorges has been given by any geologist. THOMAS AYERS.

## CANTILEVER BRIDGES.

[1254]—A friend has lately put into my hands a bundle of past numbers of your publication, KNOWLEDGE, the perusal of which has afforded me much pleasure. Your journal seems to me to supply a want.

In No. 127 I observe a description of a Cantilever bridge lately erected in America. This article was of great interest to me, as I have long advocated this system of construction. In the year 1858 I patented a "Bracket bridge." A large cardboard model of this bridge, made with my own hands, stands in the Patent Museum at South Kensington. This system was defective, and in 1864 or 1865 (I forget which) I patented an improvement, which consisted in a compound Cantilever and truss superstructure, with hinged joints at the junction of Cantilever and truss. This is the system described in your No. 127.

For several years I tried to get this plan tried by engineers, and very nearly succeeded. In one case the design was approved, working drawings were made, and the erection of piers begun. This was in 1866 for a bridge in Russia. A commercial crisis coming on, the works were stopped, and the bridge never erected after all. The bridge now building over the Forth is on this system.

In 1868 I patented a further improvement, which consisted in substituting a suspension bridge for the central truss, thus introducing further economy. I made numerous designs and estimates for bridges on this plan, but the conservatism of our English engineers was too strong for me, and consequently I have spent the last thirteen years of my life in ordinary railway engineering work in the Colonies.

I think it is a very happy idea of yours to gild your pill of knowledge by a Chess and Whist Column. You might go further and notice another scientific game—billiards, as regards which I have never come across any *scientific* treatise. The manuals which I have seen are anything but scientific. For example: The authors start by assuming that the angle at which a ball rebounds from the cushion is the same as the angle of incidence, which can scarcely be the case, as the angle of reflection is affected by the rotation in a vertical plane acquired by the ball in its journey to the cushion.

Your answers to correspondents are often very amusing reading.

E. W. YOUNG.

## PUIR DOGGIE.

[1255]—My dog having a weak leg, I wished to see if magnetism would benefit him. I held one of his paws and my brother the other, each of us holding a handle, but to my surprise the current would not pass through the dog, although it had just before passed through a friend in the same position. Can you explain this fact? IDA.

## COINCIDENCES AND SUPERSTITION.

[1256]—It seems to be very generally admitted that the most reliable evidence of supernatural appearances is that bearing on cases occurring at the time of death of friends and relatives of those who have been the victims of the apparition.

In other cases, without the appearance of anything supernatural, the fact of death having taken place has been forced upon the mind of distant relatives in a most unaccountable manner immediately after, or perhaps just at the time of decease. Whatever truth there may be in these two classes of evidence, I have no doubt much is due to mere coincidence. My own experience is limited to two instances. A few years since I attended an evening concert in a building well known to the Editor of KNOWLEDGE—the Dome at Brighton. At that time I knew my father was seriously ill. After the concert had made a good start, and when I was thoroughly enjoying the singing, a sudden conviction forced itself on my mind that my father was dead. I reasoned with myself that it was mere nonsense to allow such an idea to exist in my mind, but reason utterly failed, and I was quite prepared to hear of my father's death. A letter arrived a day or two after, and I was informed that there had been no change in my father's condition. My own health at the time was not good, and I should therefore, if "Cosmopolitan's" theory be correct (1180) be in the best condition to receive truth by the bodily forces being in subjection to the spiritual part of us.

My second experience was very similar. My wife was with her father, who was very ill, and she wrote me that the doctors had stated he could not live long. A day or two after the receipt of this news a sudden idea, which amounted to a strong conviction, took possession of my mind that death had taken place at a particular hour. It was a false conviction; my father-in-law died several months after. My health on this occasion was good.

Had death taken place in either of these cases about the time of my unreasonable convictions, the coincidence would have been accepted as matter of fact.

The next case tends to the same conclusion as that of Mr. Corbett (1166):—

In a portion of Dorset there still exists a belief, though now dying out, that when a person dies, a noise is heard at the window like the tapping of a bird. A death occurred in the house of a friend of my own about midnight, and a little later the widow and her son were in a room alone. The son lay on a sofa, tired and sleepy. Suddenly a peculiar noise was heard at the window, and what made it more than usually unaccountable was the fact that a stream of water ran between the window and the road. The gentleman was instantly wide awake, and, although a disbeliever in "ghosts," the tales he had heard in childhood came strongly to mind. After a short interval the tapping was repeated; and, again, the orthodox third time. The gentleman rushed out of the house, and opposite the window he found, not a "ghost," but a carter, who, having lost his way, had left his horses to make inquiries. He could not find the door, and had struck the window lightly with his whip across the stream.

G. HANN.

## COINCIDENCES.

4, Bellevue-crescent, Edinburgh, May 5, 1884.

[1257]—The following is from the *Dundee Advertiser* of May 2:—"On Saturday last the four-masted ship *Glencairn* arrived from Chittagong, with a cargo of jute. She hails from Glasgow, registers 1,564 tons, and has made the passage in 116 days. On Monday the ship *Trafalgar* arrived in the river. It is notable that this vessel is also a four-masted ship, belongs to Glasgow, has made the passage in 116 days, comes from Chittagong, and brings a cargo of jute, being in these five circumstances identical with the *Glencairn*."

Hardly any but "those who go down to the sea in ships" can appreciate the countless conditions which affected the progress of these two ships, so that their equal passages are quite remarkable as a coincidence, even if this were not coupled with four others of greater probable chance of recurrence. J. P. S.

[1258]—Whilst you are dealing with coincidences in KNOWLEDGE perhaps you will allow me to submit to you the following one:—

Some years ago I left my home in Scotland, and took up my residence in London. Prior to my departure I had met, on separate occasions and only for a few hours in each case, two gentlemen of nearly equal age, and bearing the same patronymic (which I shall denote by "Blanke"). They were, however, quite unknown to each other; one resided in the north of Scotland, the other in one of the English midland counties.

Well, after an interval of about four years, during which I had quite lost sight of the Messrs. Blanke, a letter from home

announced to me that (the Scotch) Mr. Blanke was proceeding to the metropolis on a visit, and that he would call upon me at my office *within the next few days*. In a few hours after the receipt of this letter "Mr. Blanke" was announced. The appearance of my visitor was slightly different from what my recollection of him led me to expect; however, I put that down to the difference which a few years would naturally produce, and his visit, coinciding completely with the information I had just received in the letter, seemed to me an indubitable proof of his identity. As for the other "Mr. B.," I had quite forgotten his existence for the time.

During our conversation I inquired after a person with whom I had reason to think that my visitor was acquainted, but the reply somewhat surprised me: "Don't know him," said Mr. Blanke. A few other remarks of my visitor also seemed to me rather incomprehensible, and we got on much better when we came to discuss topics of general interest. Not until the interview was finished, when I was reflecting as to what the causes of our misunderstanding could have been, did I think about the other Mr. Blanke; and then the coincidence was at once revealed. My visitor had been the English Mr. Blanke, who, also chancing to visit London at the same time as his namesake, had called upon me without previous notice. About a week afterwards Blanke *secundus* appeared on the scene, and was considerably surprised and amused at the coincidence I had to narrate to him. J. W. S.

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[1259]—As you seem to be rather "going in for" curious coincidences just now, I send you one in case you may think it sufficiently curious to insert. Some years ago I went to stay at B. in company with a party of friends. On the first Sunday we went to church, where the sermon was preached by a visitor, the vicar reading prayers. The sermon was fairly good, and I do not doubt the excellence of the personal character of the preacher; but in consequence of something about the tone of the discourse, one of our party gave to this clergyman the sobriquet of the "Pharisee." This title, not a very kind one, though not unkindly meant, stuck to him amongst ourselves. The good vicar, who had a comfortable, genial aspect, was forthwith dubbed the "Publican." That name stuck to him also, but strictly among ourselves. His countenance was, I think, ruddy and pleasant to behold, but there was nothing about him suggestive of the tax-gatherer of the New Testament. Three years afterwards, my wife (one of the original party) and I again visited B., and went to church on the Sunday morning. A friend—Mrs. V.—was with us. We had told her the story of the Pharisee and the Publican, and had made the remark, "How curious if they should both take part in the service." We had no reason to suppose that the stranger was staying at B. at the time, and we were not aware whether there had been any change of incumbent. Service began, the original stranger saying prayers and reading the lessons. He read from the old lectionary, though the new had by that time come into general use. The second lesson was from Acts xxiii. When he came to the words in the sixth verse, "Men and brethren, I am a Pharisee, the son of a Pharisee," our feelings were not quite what they ought to have been in church; but when the incumbent—the pleasant, genial-looking vicar—"ascended the pulpit," and gave out as his text Luke xviii., 13, "And the publican standing afar off," &c., and preached an eloquent sermon on the subject, our feelings gave us a great deal of trouble indeed, and our friend, Mrs. V., who has a strong sense of the ridiculous, underwent a martyrdom it would be difficult to describe. C. H.

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[1260]—A number of years ago my mother was residing in the north of Scotland, in a country district, and, while there, had a curious dream, immediately followed by what may fairly be called a "coincidence," allowing for the bull.

She dreamt she was calling at the house of her cousin, Captain F—, and on arriving found the front door open, and no one in attendance. She walked into the dining-room—to the right on entering—and to her horror found a coffin lying on the bare mahogany table. She particularly noticed that the lid was lying diagonally across the coffin, and on looking into it, her horror was still greater to find the dead body of her cousin, Captain F——, dressed in full Highland costume. She then awoke.

Now it happened that on that very night, and unknown to my mother, Captain F—— was attending a county dinner at the town of B——, and had intended to remain at an hotel for the night, but on its becoming known that this was his intention, several gentlemen in his immediate neighbourhood at the table chaffed him unmercifully, alleging that an easy tumble into a bed close at hand was much more to his liking than a nine miles' drive, and perhaps an uneasy tumble into the bed of some mountain stream. This proved sufficient to make F—— drive home, and on his way, his horse went over the low parapet of an old-fashioned bridge, and precipitated his groom and himself into the ravine below. The groom was instantaneously killed, and F——, who was found a few hours afterwards, did not see the day out. Now, for the coincidence, as I have called it. My mother called the following day, and found the *door open*, with *no one in sight*, and on going into the dining-room found the coffin on the bare table with the lid as I have already described, and inside it, the corpse of her cousin, *dressed in Highland costume*. The last coincidence was the strangest of all, as, whatever eccentricities the Gaels may be capable of, it is not customary with them to lay out their dead in any other but the orthodox manner. Nor was my mother aware that it had been her cousin's wish that he should be so dressed after death.

T. W. R.

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[1261]—Without attaching any importance to the following, it may, I think, fairly be considered a "curious coincidence," and as such, perhaps not beneath your notice. One evening, some years ago, I was the spectator of two or three lengthy rubbers of Whist, during which the entire run of luck was in the direction of one of the players, *viz.*, my father. Being what I may call a *family* game, his continued success gave rise to no small amount of good-natured triumph on his part, and banter on the part of his opponents. At length I—the youngest of the party, and knowing really nothing of the game beyond one or two very broad rules—challenged my father with, "I will take 'dummy' and win every trick the first round just to punish you," and, amid general incredulity, and never having really meant my thoughtless, rash assertion, I nevertheless turned up four honours, and, with ease, took all the tricks, according to promise, and this against old and, by comparison, skilled players, neither of whom were more amazed at my good luck than was I myself.

At that time I would be about sixteen years old, then, as now, very stupid at cards—taking, usually, no interest in games of any kind. B. H.

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## SINGULAR AND SAD COINCIDENCE.

[1262]—We have received the following story from the naval officer who conducted the inquiry referred to in it:—

"During the war between Buenos Ayres and the Banda Oriental, in 1844, an officer commanding one of our vessels of war was sent by the senior officer, at the request of the British Minister, to inquire into the truth of a report of Col. Gomez and five hundred of his cavalry force having been taken prisoners and put to death by General Urquiza, who commanded a body of Buenos Ayrian cavalry.

"At Maldonado, near the battle-field, he obtained clear evidence that the prisoners—officers and men—had been drawn up in line with their arms tied behind, and a dismounted lancer behind each, who on the word of command from Urquiza lanced them all to death. This he reported on his return to Monte Video.

"In 1864 the same officer was crossing to France in the steamer from Newhaven, and met on board a fine-looking young Spaniard, who, he found, came from Monte Video, and who said he recollected the siege, as he was ten years old at the time. In speaking of the barbarous character of the war the officer mentioned the facts connected with the murder of Col. Gomez and his men. When he finished the tears were on the stranger's cheeks as he said, 'Col. Gomez was my father.'

"That he should have heard the particulars of his father's death, *for the first time*, from a stranger in Europe twenty years after, was an extraordinary coincidence."

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## ANCIENT STORY AND ODD COINCIDENCE.

[1263]—Apropos of your article on coincidences, perhaps it may be worth your while to insert the following recent experience of mine. I was reading an article on schoolboys' examination blunders. One boy had said that the venerable Bede was, owing to his antiquity, called *Adam* Bede. Not remembering at the moment who the latter was, in a little perplexity as to the exact meaning of what I had read, I laid the paper aside, and, in reaching for something else, glanced over my sister's shoulder. She was reading George Eliot's "Adam Bede"! F. J. N.

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## COINCIDENCES,—PHENOMENAL VOICE.

[1264]—We seem to be getting a little mixed as to what constitutes a "coincidence," when it can be said that we must admit "something supernatural sometimes even in coincidences." I am rather afraid to attempt a definition, but it would surely have to run something like this:—"A 'coincidence' is the concurrence of events or phenomena due to independent* causes, though appearing to be due to a common cause." It is a contradiction in terms to

* No doubt one of the causes might be thought supernatural; but, *then*, could it *also* be independent?

call that a co-"incidence" which is conceived to have a "supernatural" origin or explanation, except in so far as *all* events may be so conceived. Again, it is essential to a "coincidence" (in our present connection) that, if it be a *re*currence, all the essentials shall be unperiodic. If I go the same walk, at the same hour, on successive days, and meet the same people, there is no "coincidence," unless I can establish that those people were as little in the habit of taking that walk at that hour as I myself. In short, "coincidences" must be *accidental* in every aspect.

May I be allowed to give another instance, which, I believe, will satisfy this condition. I have a craze for logarithm tables, and on one occasion bought a copy of Grunert's 5-place Logs, with which I was very much pleased; and took an early opportunity to use it. To my disgust, my result was wrong—or *would have been*—I am uncertain now—owing to a misprint, which I detected. Naturally, I threw the tables aside, resolved never to be taken in by *them* again—albeit it was a pity, because they are the best arranged tables (of the kind) I know. It was only some considerable time afterwards that, happening to look into the volume again, I saw a short notice headed "Nachträgliche Verbesserungen"—meaning "supplementary corrections"—and on closer examination I found six mentioned of which one only was in the body of the page—as any one may see who comes across these tables—and, of course, it was the one I had found! Now, that is what I call a *true* coincidence, without a trace of the supernatural to spoil it. I have many others, nearly as good, duly noted. Only yesterday I opened Newcomb's "Astronomy," a volume of 560 pages, at p. 354, the *very page* to which the index had just referred me. But that is a trifle to opening the Post-Office Directory *at random*, in the desperate hope of finding something in the *Official* part, and gradually becoming alive to the fact that the first and only words read were the ones to be looked for! But I fear I have pursued the subject too far.

I am tempted to write at some length on the subject brought forward under the heading, "Phenomenal Voice," but must confine myself to saying that the impossibility resides not in the vocal power at all, but in the capacity of the ear for distinguishing the intervals. The statement is very much the same as if the owner of a thermometer should claim that his instrument could show 1,000 different temperatures between 60° and 61° F. J. HERSCHEL.

## A TRICYCLE CATCHES A BALL.

[1265]—Reading your article upon "Odd Coincidences" in your paper of May 9, I am induced to write you with reference to a "coincident" which occurred on Saturday last, May 10, on Clapham Common. A ball had been thrown across the road from some cricketers, when there was a cry of "Lost ball." It was found embedded between the spokes of a wheel belonging to a tricycle, the rider of which was unconsciously wending his way along the road. This is the more extraordinary as it was on the "off side." How it got there I cannot understand. ALFRED W. WILKINSON.

## TENTERDEN STEEPLE AND GOODWIN SANDS.

[1266]—"And here by the way I will tell you a merry toy. Master More was once sent in commission into Kent to help to try out, if it might be, what was the cause of Goodwin Sands and the shelf that stopped up Sandwich haven. Thither cometh Master More and calleth the country before him, such as were thought to be men of experience and men that could of likelihood best certify him of that matter concerning the stopping of Sandwich haven. Among others came in before him an old man with a white head and one that was thought to be little less than a hundred years old. When Master More saw this aged man, he thought it expedient to hear him say his mind in this matter; for being so old a man it was likely that he knew most of any man in that presence and company. So Master More called this old aged man unto him and said, 'Father, tell me if ye can what is the cause of this great rising of the sands and shelves here about this haven, the which stop it up so that no ships can arrive here? Ye are the oldest man that I can espy in all this company, so that if any man can tell any cause of it, ye of likelihood can say most of it, or, at leastwise more than any man here assembled.' 'Yea, forsooth, good master,' quoth the old man, 'for I am wellnigh a hundred years old, and no man here in this company anything near unto my age.' 'Well, then,' quoth Master More, 'how say you in this matter? What think ye to be the cause of these shelves and flats that stop up Sandwich haven?' 'Forsooth, sir,' quoth he, 'I am an old man; I think that Tenterden steeple is the cause of Goodwin Sands, for I am an old man,' quoth he, 'and I may remember the building of Tenterden steeple, and I remember when there was no steeple at all there. And before that Tenterden steeple was in building, there was no manner of speaking of any flats that stopped the haven, and therefore I think that Tenterden steeple is the cause of the destroying and decay of Sandwich haven.' And so to my purpose, preaching of God's word is the cause of rebellion as Tenterden steeple was the cause that Sandwich haven is decayed" (from Latimer's "Sermons," quoted in "Chambers's English Literature").

Evidently the "legend" quoted by "A Man of Kent" [1210], with its hypothetical embankment, is merely an amplification of this story of the good Bishop's. Certainly the latter knew nothing of a tract of valuable land or a neglected sea-wall.

H. A. NESBITT.

## "TWINKLE, TWINKLE."

[1267]—"G. G. H.'s" information in letter 1228 is not correct. Dr. Drury's version, "Mira, mira" was from Miss Taylor's words, and is so acknowledged in the sixth edition of "Arundines Cami."

I have not a "Gammer Gurton" by me to refer to, but, speaking from memory, there is nothing of the kind in the old comedy.

More than thirty nursery rhymes and familiar jingles are referred to Gammer Gurton in the "Arundines," few of which can be traced there. Many are of obviously later date, such as "The old man of Tobago," and "Who comes here?—a grenadier?" &c.

J. C. FLEWETT.

[Thanks. Neither can I remember any reference to "Twinkle, Twinkle," in "Gammer Gurton's Neele."—R. P.]

## CRIBBAGE PROBLEMS.

[1268]—The answers which you have published to "H. H. H.'s" cribbage problem on p. 60, suggest some different questions, in which the amount of the opponent's score is taken into account.

The published answers, omitting some which seem to be incorrect, give the following scores:—

| | | | | | |
|---|---|---|---|---|---|
| Dealer | 75 ..... | Opponent | 28 ..... | Difference | 47 |
| „ | 74 ..... | „ | 33 ..... | „ | 41 |
| „ | 61 ..... | „ | 5 ..... | „ | 56 |
| „ | 70 ..... | „ | 32 ..... | „ | 38 |
| „ | 78 ..... | „ | 32 ..... | „ | 46 |

The following hands have been devised, the first to make as great a difference as possible between the scores; the second to make a large score for the dealer without the opponent scoring at all; and the third to make as large a difference as possible, and yet to have the opponent play rightly, instead of throwing away his best cards for the benefit of the crib. These are my best efforts to these ends. Others may, perhaps, do better:—

HAND 1.—AS PLAYED.

| | | Trump. | Crib. |
|---|---|---|---|
| Opponent . 9, 4. | 10, 9. | 5 ..... | Kn. 5, 5, 5. |
| Dealer ... 6, 4, 4, 4. | | | |

Score: Dealer, 74; opponent, 5.

HAND 2.—AS PLAYED.

| | | | |
|---|---|---|---|
| Opponent . 4, 3, 7. | 10. | 6 ..... | 4, 5, 5, 6. |
| Dealer ... 4, 5, 6. | 5. | | or 7, 7, 8, 8. |

Score: Dealer, 62; opponent, none.

HAND 3.—AS PLAYED.

| | | | |
|---|---|---|---|
| Opponent . 10, 5. | 9, 9. | 4 ..... | 4, 4, 4, 7. |
| Dealer ... 5, 5, 5. | 6. | | |

Score: Dealer, 70; opponent, 7. The opponent discarded a 4 and a 7.

A. B.

## LETTERS RECEIVED.

J. WHITLEY. Thanks; but so many spots of that shape have been seen.—E. A. C. Three-quarters of an inch diameter is unusual for hailstones; but much larger hailstones than that have fallen.—W. J. HOLLAND. Know nothing of Nap.—THOS. COMMON. We have not space; but thanks for thoughtful and suggestive paper.—JOSIAH GREEN. Such relations are too familiar to the mathematician to be dealt with at such length here. You could fill hundreds of volumes with matter of the sort.—FLORI. Had forgotten Mr. Williams' promise to write an article on "Heating Dwelling Houses."—EXCELSIOR. If you *know* you are not mistaken, then of course ♈ and not ♎ is the right sign for spring. As a mere matter of fact the earth passes the first point of ♎ Libra at the spring equinox, but then, if you know she passes the first point of Aries, mere matters of fact may count for nothing. The occultation of Venus matter seems hardly worth further discussion; what you point out came out clearly in your letter and in "F.R.A.S.'s" reply. You and he probably use the words intimation and mention in different senses. There was mention of Venus under the elements of occultations, but no mention of an occultation of Venus as visible in Great Britain and Ireland. That practically sums up the whole matter.—C. W. T. "Difference of longitude" is quite correct.—T. H. Quite

so; you are as free to deny as I to assert. It may be that you do not regard injustice as immorality, or that you do not consider it unjust to punish the innocent for the offences of the guilty (if those can be called guilty who simply acted—we are told—in accordance with qualities which had been given to them), or to act in other respects with the blind wrath characteristic of the oriental despot (wrath which appears splendidly godlike, no doubt, to those brought up as the slaves of such despotism). In either case you can deny from your point of view the imputed immorality. Or, to pass to a later part of the volume, you may see no immorality in a decision—*imputed* only, be it noticed, I utterly reject the idea that the imputation was well-founded—according to which certain men, women, and boys were to be slain, while the young girls, their daughters and sisters, were to be handed over as slaves (we know what that means) to the warriors, after a certain portion had been set apart for the priests. I have no wish to convince you that all this really is as hateful as it appears to me, or that such immorality was most wrongly attributed,—so that though it comes in company with much that is historically true, the story as a whole may be rightly described as romance. But I most decidedly object to accept your doctrine that no one is capable of acting rightly who does not accept the teaching which comes in company with what appears to me inherently unjust and therefore immoral. I may be quite mistaken and you may be quite right. But viewing matters as I do, I should be a traitor to the cause of justice and morality if I allowed a line to appear here in support of immorality and injustice, no matter under what false clothing disguised. Read history a little, and learn what atrocious cruelty and villainy have been justified by the teaching you applaud, and you will understand somewhat of my feeling on the subject. I mean to act on the good old saying, *Fais ce que dois advienne que pourra.* But observe,—I should be running counter to the feelings I express and hold if I felt any personal dislike to those who think as you do. I simply loathe what you think should be loved and have no more reason for being angry with you than I should have for wrath against one who was warmly attached to a lady whom I held in the reverse of esteem.—S. HOLLAND. I have indicated my own experience as favourable.—G. MACKENZIE.—Your idea might have been presented in much smaller space.—VACNOLL.—R. B.—LIVE AND LET LIVE. How could anything I said be understood to bear in the remotest degree on the question of originality? What could I know about a system which if I understand you aright, is preserved as a secret, unless I had paid for the knowledge? As I have not done so, I am quite in the dark,—and obviously have not claimed to be otherwise.—S. FOSTER. Pardon me, I think your anecdote illustrates rather how naturally some dreams come true. What more natural than that your sister should have dreamed of her old friend as in the same place with her—and that place, London, being rather large, the circumstance, that the dream came true, can hardly be regarded as very wonderful.—A. KITSOM.—A. SINCLAIR.—A. AITKEN. Thanks.—J. BINDON CARTER. I thought you were funning, so followed suit. To treat the matter with due gravity,—let $g$ be terrestrial gravity and $\gamma$ the gravity in another planet, let $m$ be the average height of our men, and $\mu$ the average height of an entirely supposititious (nice word) race of men in the other planet. Assume that the weight of those extra-terrestrial men is no more burdensome to them than our weight is to us. Now it has been shown that strength varies as the cross-section of the muscles, or as the square of their linear dimensions, consequently we have strength of our men : strength of those others :: $m^2 : \mu^2$, while weight of our men : weight of those others :: $m^3 g : \mu^3 \gamma$; consequently by our suppositon $m^2 : \mu^2 :: m^3 g :: \mu^3 \gamma$, or

$$\mu : m :: g : \gamma.$$

Apply this formula to the case ofMars, and you will find that if there were Martian men, and they were as active as our men (under similar supposed conditions) they would be about 14 feet high.—H. P. MALET. Received with thanks.—J. HAMMOND, W. J. HOLLAND. Don't play Nap (indicative mood).—J. BUTTLE. Thanks.—ALEX. THURBURN. Thanks for interesting story. The evidence is very strong. Wish the story could have been condensed. As you say, one might fairly expect *some* spirit utterances to be other than trivial. One would be disappointed, so far as I can see.—W. BRISTOWE. Thanks.—E. W. YOUNG. Many thanks for your book, which I shall examine with great interest.—T. W. WINCH. The deviation of Cancus from "Caulker" House or Calk House, seems very doubtful—like many others of Dr. Brewer's.—J. M. BACON. I do not know of any work discussing popular prognostications of weather. Venus will scarcely be visible to the eye in full sunshine before July,—she will be at her highest in August.—ROB. B. COOK. You are mistaken as to thanks, which were offered at the outset when those papers were proffered with the remark that they were placed at our service.—J. T. ROUTLEDGE. Reflex action, doubtless.

# Our Mathematical Column.

## EASY LESSONS IN CO-ORDINATE GEOMETRY.

BY RICHARD A. PROCTOR.

(*Continued from p.* 338.)

### EQUATIONS TO LINES.

WE have seen how the position of a point is expressed by means of co-ordinates; we proceed to shew how the forms and positions of lines, straight or curved, may be determined by the same means.

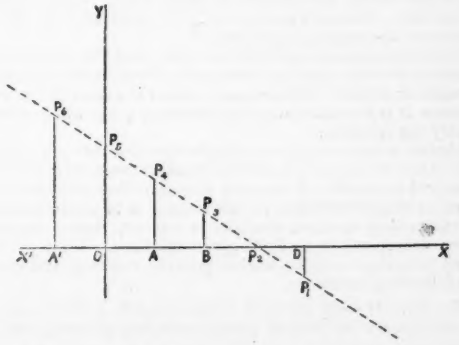
20. The learner has already seen that in geometrical problems in which the position of a point has to be determined, a certain number of relations must be given; and that, if one of the number is wanting, though we cannot determine the position of the point, we can, *in general*, determine a line straight or curved on which the point must lie. Thus if three points are given in position, the centre of the circle passing through them is known; but, if only two points are given, the centre of a circle passing through these two points is no longer a determinate point, since an infinite number of such circles can be drawn; yet we know that the centre of such a circle must lie on the straight line bisecting at right angles the line joining the two points. Again, if the base of a triangle is given in position, and a side, and the included angle, in magnitude, the vertex of the triangle is determined; but, if the included angle is not given the vertex is no longer a determinate point, yet it must lie on the circumference of a circle, having that end of the base from which the given side is to be drawn as centre, and the length of that side as radius.

We say, above, *in general*, because in some cases the omission of a single datum leaves the point altogether unrestricted.

Now we have seen that if a pair of equations of the form $x=a$, $y=b$ are given, the position of the point $x$, $y$, is fully determined. And since, if any two independent equations between $x$ and $y$ are given, we obtain by their solution one or more such pairs of equations as $x=a$, $y=b$, two equations enable us to determine either a point, or some finite number of points whose co-ordinates satisfy both equations. Hence we may expect, from what has been shown above, that *one* equation between $x$ and $y$ will enable us to determine, not a point or a finite number of points, but a line straight or curved, the co-ordinates of every point of which satisfy the given equation. And this, in general, is found to be the case. We shall consider two examples.

21. Take the equation

$$2x+3y-6=0 \quad (1)$$



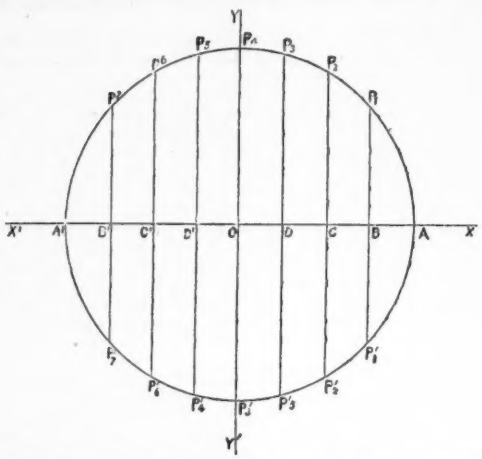

We are unable to determine from this equation the values of $x$ and $y$; but we can assign any value we please to $x$ and obtain a corresponding value for $y$. Each such pair of values of $x$ and $y$ determines the position of a point whose co-ordinates satisfy (1). Thus give to $x$ successively the values, 4, 3, 2, 1, 0, $-1$; corresponding to these values of $x$ we obtain for $y$ the series of values $-\frac{2}{3}$, 0, $\frac{2}{3}$, $\frac{4}{3}$, 2, $\frac{8}{3}$. Along X'O X measure O A', O A, A B, B $P_2$, and $P_2$ D, each equal to one unit of length, so that O D, O $P_2$, O B, &c. are the successive values we have assigned to $x$, and draw the ordinates D $P_1 = -\frac{2}{3}$, B $P_3 = \frac{2}{3}$, A $P_4 = \frac{4}{3}$, $A_1$ $P_6 = \frac{8}{3}$, and take along O Y, O $P_5 = 2$. Then $P_1$, $P_2$, $P_3$, $P_4$, $P_5$, and $P_6$ are the six points whose co-ordinates we have determined, as satisfying (1). An

obviously we may give to $x$ any values we please intermediate between the values we have chosen, or greater than 4, or less than $-1$, and deducing corresponding values to $y$, obtain any number of points whose co-ordinates satisfy (1). We shall find that all these points lie along the dotted straight line in the figure.

22. Again take the equation

$$x^2+y^2=16;$$

as before we cannot obtain from this equation determinate values of $x$ and $y$. Assigning to $x$ the values 0, 1, 2, 3, 4, we obtain for each such value two values of $y$ equal in magnitude but of opposite sign. These successive pairs of values are $\pm 4$, $\pm\sqrt{15}$, $\pm\sqrt{12}$, $\pm\sqrt{7}$, and 0. If we give greater values to $x$ we obtain




imaginary expressions for $y$, since such values of $x$ make $y^2$ negative. Again, the negative values of $x$ $-1$, $-2$, $-3$, and $-4$, give the same values of $y$ as the corresponding positive values of $x$, and negative values of $x$ numerically greater than 4 give imaginary expressions. Along X′ O X take O A = O A′ = four units of length, O B = O B′ = three units of length and so on, and draw through the points thus obtained $P_1$ B $P'_1$, $P_2$ C $P'_2$, &c., so that $P_1 B = P'_1 B = \sqrt{7}$; $P_2 C = P'_2 C = \sqrt{12}$, and so on. Then the points A, $P_1$, $P_2$, $P_3$, &c., $P_7$, A′, $P'_7$, $P'_6$, . . . . . $P'_1$ are all points whose co-ordinates satisfy (2). We can further give $x$ any values intermediate to those given, but not numerically exceeding 4, and obtain any number of other points whose co-ordinates satisfy (2). We shall find that all these points lie on the circumference of the circle in the figure.

These examples are sufficient to show that, in general, a single equation between $x$ and $y$ represents in Co-ordinate Geometry a line straight or curved. Such a line is called the *locus* of the equation, because it is *the place* in which lies every point whose co-ordinates satisfy the equation.

Similar remarks apply to a single equation between $r$ and $\theta$.

It is one of the objects of Co-ordinate Geometry to determine the form and properties of the loci corresponding to given equations. Another important object of this science is to obtain the equations corresponding to lines, straight or curved, drawn according to given definitions, or to fulfil given relations. We have used the word *locus* above: it has a more general meaning, and we append the following definitions.

23. *Def.* If every point of a curve satisfy a given relation, that curve is called the *locus* of points satisfying the given relation.

24. *Def.* If that relation is given in the form of an equation which is satisfied by the co-ordinates of every point of a curve, that curve is called the *locus of the equation*.

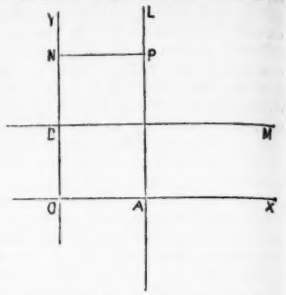
25. *Def.* And conversely, if we can express by means of an equation the relation which subsists between the co-ordinates of every point of a curve, that equation is called the *equation to the curve*.

*Note.*—The word *curve* in the foregoing definitions and throughout these papers includes the *straight line*. When a distinction is to be drawn between lines that are, and lines that are not, straight, we shall speak of the latter as *curved lines*.

### THE STRAIGHT LINE.

We proceed to obtain equations to straight lines drawn according to different conditions.

26. *To find the equation to a straight line parallel to either of the co-ordinate axes.*




Let the straight line A L, parallel to the axis of $y$, meet O X in A; and let O A = $a$. From any point P in A L, draw P N parallel to O X, and let P N = $x$. Then P A O N is a parallelogram; hence

P N = O A, Euc. I., 34.

That is $x=a$,

the required equation.

Similarly, if the straight line B M, parallel to the axis of $x$, meet O Y in B and O B = $b$, the equation to B M is

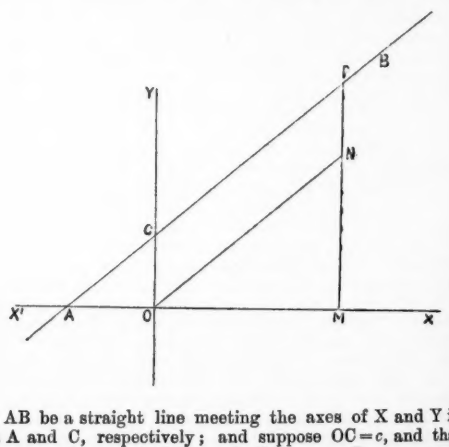
$y=b$.

The equation $x=0$, obviously represents the axis of $y$; and the equation $y=0$, the axis of $y$.

27. It is clear, also, that an equation of the form $x=a$, or $y=b$, necessarily represents a straight line parallel to the axis of $y$ or $x$ respectively, since such an equation expresses the relation that every point of the line which is the locus of the equation is equidistant from one of the axes, a relation which can only be true of a straight line parallel to such axis.

28. It is clear, also, that equations of the same form are obtained for straight lines parallel to the axis when these are oblique; and also that equations of these forms necessarily represent lines parallel to the axes when these are oblique.

29. *To determine the equation to a straight line inclined to the axes.*




Let AB be a straight line meeting the axes of X and Y in the points A and C, respectively; and suppose O C = $c$, and that the trigonometrical tangent of the angle C A O = $m$. From any point in AB draw P N M parallel to O Y, and from O draw O N parallel to AB. Let the co-ordinates of P be $x$, $y$; then

$$\begin{aligned} y &= PM = MN + PN \\ &= OM \tan NOM + OC \\ &= mx + c \end{aligned}$$

the required equation.

30. If $c=0$, that is, if the line pass through the origin, the equation becomes

$$y=mx.$$

And it is clear also, conversely, that every equation of this form, that is of the form

$$\frac{y}{x}=m$$

represents a straight line through the origin inclined at an angle whose tangent is $m$ to the axis of $x$, since from the definition of a trigonometrical tangent it follows that the relation expressed in the equation is true of the co-ordinates of every point in such a line, and of such points only.

31. As we shall frequently have occasion to make use of the equation to the straight line in the form

$$y=mx+c$$

it will be well to call the attention of the student to the meaning of the constants in that equation. Thus $c$ or O C is the part of O Y cut off by the line, and is positive when C falls above O, negative when C falls below O and vanishes when C coincides with O. Again $m$ is the tangent of the angle B A X or N O M,—that is

of the angle through which a line coinciding with O X would have to revolve about O in the positive direction, in order to become parallel to A B. If this angle is less than a right angle as in the figure, $m$ is positive; if it be greater than a right angle, $m$ is negative; and if it be a right angle, $m$ vanishes.

The student should exercise himself in discussing these variations. It will be found, and we shall in future assume, that when a property has been established algebraically for any particular case the property is true in all cases if proper attention is paid to the directions in which lines are drawn and angles measured.

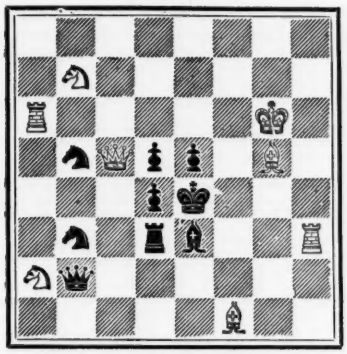
*(To be continued.)*

# Our Chess Column.

## SELECTED PROBLEM.

By G. L. Carpenter.

Black.



White.

White to play and mate in two moves.

## HOME CHESS PLAY.

By Richard A. Proctor.

I HAVE found myself falling into the mistake which I noted in others. It is absolutely idle to undertake to teach the home Chess-player so many lines on each particular opening at Chess as I have run into already in dealing with the Philidor Defence, or as "Mephisto" gave in dealing long since with one form of the Giuoco Piano, and recently with the Allgaier Gambit. Only those who either play Chess professionally, or, being amateurs, are ready to give much more time to Chess than it really deserves, can possibly study the various lines of attack and defence which may be entered on in any opening studied down to the tenth or twelfth move, still less those which may be followed when the game is carried on to the twentieth move or so. To study these well enough to retain them always without confusing any sub-line with another, may be possible with those who have phenomenal memories, and will devote their powers in that direction to the Chess-openings, or with those who are possessed by the Chess-madness (which happily is seldom of long duration). But the average home Chess-player cannot learn all these lines, even when shortened as I proposed to try to shorten them.

Yet the home Chess-player need not therefore resign himself to play always at a disadvantage with the book-learned Chess-player. Under wiser guidance than that which I myself have given (hitherto) he can very easily learn all that is necessary for safety from such defeat as mere book-learning can give. Instead of learning what are the possible lines following from any opening, he should consider rather what are the only lines he need care to follow, whether playing the attack or the defence. It is very easy for him to study quite sufficiently a certain number of openings, and certain selected lines under such openings, without considering what would be best if his opponent played such and such moves along lines which he himself does not propose to follow. The idea entertained by many, and to some degree suggested by the method of treatment which Staunton, Wormald, Bird, and others have adopted in their guides to the game, is that, if you do not know at least as much as is contained in one of the standard Chess-books you are almost certain to lose against a player who knows them thoroughly, for he can select a line which leads to a bad game for you, whether you are playing the attack or the defence. But this idea is entirely erroneous. Nine-tenths, or more probably ninety-nine hundredths of the book-lore can be dispensed with altogether, if all you need is to be on even terms with the book-learned. All the openings dealt with in the books are interesting as Chess studies; but a knowledge of them is by no means necessary to Chess proficiency. They are most useful as Chess exercises, but not as a part of Chess knowledge.

Take for instance the opening with which I have been laboriously dealing in my last three papers,—Philidor's Defence. Well in the first place, as second player you can avoid the defence altogether, and all the trouble of inquiring into its complications—by the simple course of omitting to play 2. P to Q3 in response to 2. Kt to KB3. As first player you cannot, if you have played 2. Kt to KB3 (too valuable a second move to be left unused) avoid having to meet the Philidor Defence. But you can avoid every one of the lines I have so carefully considered by simply playing for your third move 3. B to QB4 or some other move which you may prefer,—instead of 3. P to Q4 as in every case thus far considered. Whatever line you thus take, you make all the analysis hitherto presented a dead letter. Of course on whatever line you thus enter there is *some* book-lore; but you have disposed of much more than is left. For you are not yet at the end of the saving effected by omitting to play 3. P to Q4 if you so please. Whatever move you take, the books if they show more than one reply for second player, show more than one subvariation in each. Whichever one he selects you can have your own selected subvariation and escape all others, at every step where the books give you choice of two or more lines. The process of sifting becomes indeed less and less effective at every stage, so far as the cutting out of unnecessary book-lore is concerned, but it is in greater or less degree effective to the last.

But the chances are that unless you yourself take to Philidor's Defence, you may never have occasion to oppose it at all; while when you do you have a steady and rather easy game to conduct. Practically by deciding, should you deem it well, never to play 2. P to Q3 in response to 2. Kt to KB3, you are enabled to pass over the whole chapter relating to the Philidor Defence, and to go on to an opening the study of which will (in that case) be more useful to you.

Now by acting on this principle, the *essential* part of the study of book-lore may be made a very easy and simple matter indeed. But manifestly Chess is a game worth some study. The question each player should consider is, how much time and attention he can afford to give to the game. When he has settled this, he can decide which openings, and which lines under each opening, he may deem it well to study. For instance, one who has scarcely any time to give to the study of Chess, but yet very much enjoys Chess play, and objects seriously (as many do) to being beaten through mere book knowledge, may decide to open always on some line not dealt with in the books, yet promising fair assurance of safety. There was a strong player at the Westminster Club for example, who, when first player, after P to K4 on both sides, would play his KKt to K2, and thence to KKt3. He beat Steinitz on a game thus opened, so that the possibility of the existence of first-class Chess power without knowledge of the book openings must be conceded. Or, if not quite so unwilling to look up book knowledge, which is really Chess experience, the player may limit himself to certain openings. With the first move he may always play Kt to KB3, after both Kings' pawns move out two squares; or he may always take for his second move either this or P to KB4, and so forth. With second move he may meet 2 Kt to KB3 *always* with Kt to QB3, and if a Ruy Lopez attack follows, may adopt a constant line of defence, or if an Evans gambit is proffered he may systematically decline it. So if at second move the first player proffers the KBP, second may constantly decline the gambit.

In such ways as these, a home Chess player may limit to any extent he pleases the amount of book-learning necessary for mere safety. But it should be hardly necessary to say that the more he studies Chess openings, even on lines which he may never care to follow in actual play, the more he will grow in Chess power. If it is excellent practice to watch two good players, or to play thorough good Chess games, how much more improving still must it be to examine lines of opening to the analysis of which many generations of the finest Chess players have devoted their powers.

I think I will ask "Mephisto"—my own work pressing rather too heavily on me—to give certain selected lines of opening which every home-player should thoroughly master;—leaving for the present the complete analysis of even any single line of opening to those who, if not professional Chess players, have much time to devote to the game.

With regard to "Mephisto's" first note on my last communica-

tion (KNOWLEDGE for May 9, p. 339), I may remark that although the second player has a cramped game,—especially after he has played (as I think he must) 7. P to QR3 and Queen back to her square,—it appears to me that White's attack is not so strong as it looks. If after 7. Q takes B—P to QR3, 8. Kt to Q5—Q to Qsq, White plays 9. B to KB4, to be followed by Castles Q side, &c., it seems to me that Black may with care develop an effective counter-attack by P to QB3, P to KKt4, B to KKt2, and so forth.

At a first view I thought that in the case inquired into by a correspondent (see the other foot-note on p. 339), White might take KBP, and if Black took Bishop, might regain the piece by checking with Kt at KKt5. But it is obvious that Black could take the Knight though supported by QB, White's own Queen being *en prise*.

*(To be continued.)*

## Our Whist Column.

### AVERAGE PLAYERS.*

THERE is a class of persons commonly described as "fair average Whist players." You may have met them; if not, you will recognise them from the following description: They have mostly played Whist, or think they have, for from 30 to 120 years—I don't think I have come across more than three who have exceeded the latter period, and even they were exceptions—they despise any one who has read a book on Whist, and consider him mechanical, themselves being bound hand and foot to half-a-dozen cast-iron rules, mostly wrong. I heard one of them rejoicing once that Mr. Clay was dead, on the mistaken ground that he did hope now he had heard the last of him. They detest Cavendish still more, though how he has injured them, who have never even seen his book, it is difficult to say. They are intensely superstitious, believe in numerous fetiches, and when they lose a rubber at once attribute it to some malignant influence of the cards and seats; if they have deliberately thrown it away themselves they are still of that opinion. With regard to their play—

(1) They lead singletons when weak in trumps and the game in no apparent danger; if they make a trump, which they might have done with equal certainty when the suit was led by somebody else, they are apparently much gratified; the effect on the mind of their partner is of no consequence.

(2) With two small trumps and a bad hand they lead a trump, and assign, as a reason, that their adversaries are at three, and that is the only way to save the game.

(3) When second player they never omit to ruff a certain trick of their partner's if weak in trumps, on the ground that it is the only chance of making a trump, thereby announcing loudly their weakness to their adversaries, and preventing their partner from developing any game he may have; even if moderately strong in trumps there is no certainty that they will not do this.

(4) They pass a winning card of the adversaries, if there is any possibility of being over-ruffed.

(5) They usually trump any winning card of their partner's below a ten, and below a seven invariably, whether any one else followed suit the round before or not,—unless very strong in trumps, when they will trump nothing for any consideration: they would sooner lose the game.

(6) They decline to return their partner's trump for several curious reasons. I. Because an honour being turned up to their right it is impossible for them to do so. II. Because they won with a Queen, and were afraid of killing their partner's King. If they won with a Knave, because the entire strength of trumps must be with the right hand adversary—the triumphant way in which he will make this remark is in itself almost enough to prove the average Whist player. III. Because they are able to ruff the suit on account of which their partner led trumps. IV. Because they thought their partner had no more, and many similar reasons.

(7) If with King, Queen, and another of their partner's lead, they make the Queen, they will carefully wait for hours in order to make the King. Those of them who by many years' practice have become skilful in annoying their partner, play the King first and then wait: but they are a rather superior class.

(8) With the adversary leading trumps they open a new suit every time they get in.

(9) They occasionally notice their partner's discard, but are compelled to lead that suit because they have a tenace in it and only two small ones in the suit asked for.

(10) If by any chance they see a call for trumps they always select the card most likely to deceive their partner as to what trumps they hold.

Now, will you kindly explain to these worthy people that all this is really not Whist, and that a better style of play might easily be acquired by, say, six hours a day steady practice for ten or fifteen years, without any necessity for reading any book at all.

You may enquire why, if they pay no attention to Moses and the Prophets, they should attend to you? *Why*, I am unable to say, but there is the undeniable fact that they do draw some line between a book and a periodical. In abstruse disputes, such as what is a revoke? is it a misdeal? they never think of looking at the rules of Whist, they don't believe in them, but they are always willing to refer the matter to the *Westminster Papers*. Again, I have often seen the average player with the *Papers* in his hand; that he was reading them I am not certain, but that shows they are not repugnant to his feelings, and I really think if you were to put the matter to them nicely they might alter their play to some extent, and it is quite unnecessary to specify what any alteration must be.

PEMBRIDGE.

* From a Letter by Pembridge to the Editor of the *Westminster Papers*.

ACCORDING to the *Engineer*, the Caledonian, North British, and Glasgow and South-Western Railways are rapidly fitting their carriages with the Pintsch gas apparatus; consequently, travelling in Scotland will, so far as light is concerned, soon be better than in England.

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